Nadia Dario
Luca Tateo *Editors*

New Perspectives on Mind-Wandering

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Prologue

The Wandering Mind

Loose strings of creative thought. The mind's journey in time, space and knowledge. An Artist's Wandering. (Diana. B.F. Warren – Holly, University of Hertfordshire School of Creative Art)

Introduction

The mind is always engaged. The mind wanders. The mind is invited to score the sky as we look out the window and goes on marvelous journeys as we catch butterflies.

> Through mind-wandering, we invent tell stories, expand our mental horizons. Mind wandering underwrites creativity (Corballis, 2015).

What does the brain do when the mind wanders? Does it wonder? Does it create visions? Does it tie loose ends and open new possibilities? Is it at its most creative?

This short essay wants to investigate the journey the mind takes when being itself, following a natural path and drifting toward currents of thought that lead beyond the moment.

> All that is gold does not glitter,
> Not all those who wander are lost;
> The old that is strong does not wither,
> Deep roots are not reached by the frost.
> (Tolkien, 1968)

Mind wandering may thread loose strings of creative thought to unsolved problems and unanswered questions. The past, present, and future work along with each other creating infinite possibilities, and maybe the mind in these moments is at rest, dynamic rest.

Some suggest meditation as a way to settle the mind and find peace at last. But maybe the mind is happiest and fulfilled when traveling in time and space. It is the individual who judges the calm from the storm. The mind is itself. Should it be tamed or listened to?

The wandering mind has gained interest in the last decades. Interest in it has evolved and developed different titles to list a few, spontaneous thought, stream of consciousness, daydreaming, stimulus-independent thought, and task unrelated thought. Which one best suits this phenomena?

In Search of an Adequate Title

Interest in mind wandering has fluctuated over time as the foundations of psychological research allowed space and wonder on the subject. Relegated to a corner with little or no attention, it slept and created no wonder. As Callard states (Callard et al., 2013), behaviourism influenced the depth and width of research, and mind wandering was not perceived as a constructive activity under any aspect. Some interest sprouted from daring research conducted by John Antorbus (Antrobus, 1968) and Kenneth Pope (Pope, 1968) in the 1960s, and then it fell in shadows till

Klinger (1971) and Giambra (Giambra, 1974) revived the topic but as Callard (2013) states research remained in the shadows and never made it to any prominent journal. Day dreaming was the common word used to describe the phenomena. As days, come and go so did interest.

As cognitive science emerged so did interest in daydreaming. Research gathered a momentum, and the term daydreaming became reductive. Callard (2013) notes the changes in terminology from daydreaming to spontaneous cognition to spontaneous thought to fantasy proneness to mind wandering that appear in journals from 2006. One interesting aspect of the development of research in mind wandering is the parallel between the growth of cognitive neuroscience and the term default mode network where the two gain interest and depth. Finally, science has noticed that the phenomena has an important place in brain functions. This demonstrates that interest in one branch of science poses questions and queries that draw out hidden aspects that were once neglected or overshadowed by more prominent issues. Callard (2013) also considers the important shift made in recent time by mind wandering from cognitive psychology to cognitive neuroscience.

Out of the Blue

Mind wandering seems to take us on a journey of its own. While engaged in an activity, our minds move our focus on an apparently distant topic. Is this day dreaming? Are we dreaming? Are we spontaneously shifting our attention? Are we induced to steer away? Are we taking a break? Michael Corballis (2013) states that our mind wanders throughout the day. At night and during the day, our brain is travelling back and forth anchoring our attention in different places. Its travels have also included different titles.

Its journeys start out of the blue and into the blue. Like a sailboat travelling the seas, the mind travels along waves. The eyes act like the rudder. It has been proven that during mind wandering the brain produces alpha waves (Gruberger et al., 2011). These are correlated to peace of mind and creative thinking. The act of mind wandering happens when the mind is fully engaged in an activity. Here brain regions work simultaneously creating an overlap of seemingly different functions.

Why Do We Wander and Simultaneously Wonder?

It has been proven (Corballis, 2013) that wandering happens in regions of the brain that are not immediately involved in perception. So are the eyes the rudder? Or are they closed portholes?

Mind Wandering and Distraction

Distraction is seen as dis-attention and loss of focus. A sort of withdrawal from the current scene that one is in to shift into another dimension. What if it is a need to reconnect? Could it be a natural coffee break for the mind? The need to sort out all the information and stimuli that are being absorbed? Could it be just a momentary disconnection?

It seems that the brain needs to alternate between focused attention and mind wandering (Smallwood, 2013). It is physiological. It is the price we pay to live in a multi stimuli world.

There is so much that can be absorbed and digested. Then comes storage of memories, our story and human history need an abode and humans love stories. Stories are a way of time travel, a flexibility that only we have.

Humans get distracted, pulled away from one end to move into a fleeting moment in the past of jump into the future in order to connect or reconnect loose strings.

We try to tame distraction through meditation and recently mindfulness but how difficult is it? The more we try to put a bridle on our thoughts, the more we realize how many we have and how attached we are to them. Can peace of mind be correlated to reconnection by threading thoughts into an invisible fabric of order and silence?

It goes without saying that negative thoughts and negative mind wandering as in obsessions generate a thoughtscape of chaos and destruction. This wasteland creates its own lunar scenery.

Where Does the Mind Travel To?

Time. Past, present, and future. A continuous passage. Relations that events have with each other, indefinite and continuous thread of occurrences.

> The indefinite continued progress of existence and events in the past, present and future regarded as a whole (Google.it, 2018).

Memory. The place where time leaves its mark by storing our story as humans and individuals. As Corballis (2013) states, memories provide us with places where our mind can wander. Furthermore, it nourishes imagination and creates fertile ground for our wandering journeys.

Stories. Human life relies on stories. They are the currency of life. People need stories in order to find meaning. They connect events and characters. They answer questions and create new ones (Gopnik et al., 2018). They juggle our lives.

Mind wandering travels in time digs in memories and juggles stories.

Michael Corballis (2015) states that our lives happen between the day we are born to the day we die and we can travel beyond both. Mind wandering takes us before and beyond. There seems to be no place where we can wander.

So this traveling we do, is it a destination or a process? The faculty of rewinding, pausing, and fast-forwarding memories as stories in time allows incredible flexibility. Can we say that this flexibility allows connections that tie loose strings? Create the eureka moment of enlightenment?

Ripples of thought create intricate patterns and build new possibilities. The overlapping of activities in the brain allows new routes to be formed and consolidate old ones. Corballis (2013) underlines that our cognitive maps are very pliant.

Eagleman (2011) states that when an idea arises and steps out of the unconscious it has been wandering around our neural circuitry for perhaps days or years. Many famous people from scientists to artists admitted that their breakthroughs just happened with no previews.

Our minds just work their way in the meanders of our unconscious travelling our neural motorways and roads without much apparent assistance then grace us with the "share" button when ready. As Eagleman (2011) states, "Just give the brain the information and it will figure it out."

Wandering Inventiveness

When the mind wanders, it seems to be playing as in practicing a task that will be needed in the future. As humans, we do plenty of practice through play. This is needed in order to be able to adapt to a situation when it arises in real time. Creativity plays a vital role in this process as Corballis (2013) states, creativity depends on mind wandering. Therefore, do we play at being creative or does play encompass creativity. Maybe creativity needs play to express itself, and play is the training ground for creativity.

When we play, we experiment what has been demonstrated and will create new and personal visions. This happens when the mind is left to wander? Engulfed in our personal stories our inventiveness emerges as we connect and propose our visions. We create repertoires of our experiences (Corballis, 2013). There would be no discoveries if we were to stick to known pathways. So playfulness is an attitude for proficient mind wandering, it acts as an incubator keeping ideas warm and running while the correct associations are found. Creative thoughts flow incessantly between generating new possibilities and critical evaluation (Christoff et al, 2016). Mind wandering is part of our perpetual rewiring. Like the heartbeat and our breathing, the mind beats and breaths where there is an inflow and an outflow that keeps us alive and tuned in.

New lands were discovered through travelling when little was known to us. The mind wondered if there were distant shores and possibilities to experiment with?

Inventiveness and creativity are part of human mental processes that have enabled us to always go a step further.

Mind Wandering Activities

The mind wanders and the body? Are there activities that are associated with mind wandering?

Here is a potential list.

Doodling.
Colouring in.
Walking and other sports such as running where attention is not the main focus.
Kicking stones.
Sky gazing.
Hair twitching.
Flying a kite.

Temporary Conclusion

Mind wandering is a multidimensional activity. It seems to happen spontaneously. It takes us through time, space, and memory. It incessantly rewires thoughts tying loose strings and allows new connections to move our thoughts in any direction. It gives us respite from tedious activities and ignites our imagination. It can make us happy, ask questions, and catch butterflies. It welcomes innovation though problem solving, thus helping us adapt to an ever-changing world. Let the mind wander, it knows what it is doing. Sit back and wonder.

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Claudia Pelagatti graduated in Psychology at the University of Florence, Italy, and obtained her PhD in Neuroscience from the same university. Her main research interests are mind-wandering, autobiographical memory, and pupillometry.

Guillaume Pepin After a PhD in cognitive neuroscience on mind-wandering, Guillaume PEPIN works on the orientation of high school students at Université de Technologie de Troyes. What should students need to make better orientation and career choice? What should be improved in the actual system, and what are the

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Gerhard Stemberger is a sociologist and psychotherapist (Gestalt Theoretical Psychotherapy) in Vienna, Austria. He is a member of the teaching faculty of the Austrian Association for Gestalt Theoretical Psychotherapy (ÖAGP). Before shifting the focus of his professional activities to scientifically based psychotherapy, he was head of the multidisciplinary social research unit of the Vienna Chamber of Labour. He was president of the International Society for Gestalt Theory and Its Applications (GTA), and editor of several scientific journals, among these peer-reviewed *Gestalt Theory – An International Multidisciplinary Journal* (De Gruyter/Sciendo). His research interests are metatheoretical issues in psychotherapy, naïve psychology, mental health, and clinical applications of Gestalt theory.

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Chapter 1
Introduction. The Lines, Circles and Zigzag on Mind-Wandering

Nadia Dario and Luca Tateo

"New Perspective on Mind Wandering in Education" presents a body of studies and research that deal with mind-wandering and shows the points of convergence and divergence among them, suggesting which are the conjunctions with learning in educational settings.

Generally, we can define *mind wandering* (MW) as a conscious experience where the mind wanders away at different levels of disconnection from here and now towards inner musings (Kane et al., 2007; Killingsworth & Gilbert, 2010), but the discussion on its definition is recursively considered by our authors.[1]

Mind-wandering is a complex phenomenon that deals with dimensions of mental activity such as intentionality, attention, motivation, emotion and performance, which are part of the educational domain. MW represents a dilemmatic object in pedagogical and psychological research, because it remains split between positive and negative implications. Just to give an example, in cognitive sciences, mind-wandering correlates with cognitive control. On the one hand, it is a failure to constrain thinking to task-relevant material; on the other hand, this failure in control facilitates the expression of self-generated mental contents.

[1] An interesting analysis on this aspect in cognitive, clinical psychology and neuroscience is offered by Pelagatti et al. (2020). However, in the chapter, the more common definition in literature is reported: Mind-wandering is a "shift in the focus of attention away from the here and now towards one's private thoughts and feelings". This shifting away is generally spontaneous, although there is evidence that it may also occur intentionally (Seli et al., 2016).

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"New Perspective on Mind Wandering in Education" aims at providing a landscape view of the phenomenon, from different perspectives and interpretations, without imposing a single viewpoint. In particular, the book deals with some of prototypical dimensions and instances of mind-wandering that have an impact in the educational field (O'Neill et al., 2021, p. 2599):

(a) *Task-relatedness* that captures the extent to which one's thoughts pertain to a primary task or to a task-unrelated content. Barron et al. (2011) and Smallwood and Schooler (2006) suggest that more highly prototypical instances of MW tend to include thoughts that are unrelated to a focal task (i.e. TUTs), as opposed to task-focused thoughts.
(b) *Intentionality and consciousness* (i.e. whether thought is deliberately or spontaneously engaged[2]).
(c) *Thought constraint* that distinguishes between thoughts that are constrained and unconstrained by attention where MW is associated with a greater degree of *freely moving thought (FMT)*.

Thus, the text is fully inserted into the debate about MW's dimensions and their relatedness or dissociation (O'Neill et al., 2021). The book deals with the relationship between the main domains of attention, memory, perception and performance (Callard et al., 2013), but also considers intentionality, temporality, motivation, emotion, creativity and acquisition of new knowledge.

Finally, it discusses the methodological issues concerning the idiographic and nomothetic approaches in the MW research. The former concentrate on the uniqueness, specificity and unrepeatability of the individual (*idios*) and try to govern it and to bring it back to general laws (generalists). The latter adopt a measurative approach and try to find stable and recursive laws (experimentalists).

Therefore, the book intends to overcome the limits set by generalists and experimentalists, whereas the former criticise the latter for its neopositivist paradigm. The experimentalist paradigm claims instead that the scientific nature of knowledge is linked to the use of quantitative methodologies that provide measurable results. However, neopositivism cannot be dismissed by just an a-historical and obsolete criticism. Scholars in this volume are aware that thinking is marked by self-awareness and external reality. The problem is instead a poor conceptualisation of both consciousness, environment and their relationship. The latter becomes complex, consisting of elements that interact in a non-linear manner so that even though thought can no longer be considered such, it must still be able to deconstruct and restructure consolidated schemes, and follow inaccessible roads by making

[2] Seli et al. (2016) claim: "Voluntary shifts of attention to TUITs would seem to involve higher orders of control in information processing or be motivationally determined and to be benign because of their controlled nature. However, involuntary shifts of attention from the task at hand to TUITs would seem to involve lower orders of control in information processing and not [be] motivationally determined; in addition, involuntary shifts may be less benign because they are uncontrolled" (p. 606).

connections that have never been practised before, getting rid of any rigidity. Hence, thought places MW among its postulates.

Our prologue represents MW as a mind's journey in time, space and knowledge. As in a "loose string of creative thought", this book moves along imaginary "lines" and "circles" of scientific knowledge.[3] In the first section, represented as "lines", the authors show their perspectives on the issues of attention (selective and sustained), the influence of age, embodiment, consciousness and experience related to MW. Each time the authors expand the planes creating new lines of inquiry.

In the second section, these "lines" become "circles" of knowledge on methodology (tasks and measurement), intervention (auditory beat stimulation and mindfulness practices) and creativity, in which there are always profitable, decisive and retroactive exchanges between information that each group or author activates. In this manner, we recreate a dance of interacting parts: scrolling through the different contributions, one can grasp the rhythm of convergences and interconnections that animates them.

In the last part "zigzag", we discuss the absence of a unified theoretical perspective, in the pedagogical field, based on a generative-systemic approach, attentive both to the developing processes of emergence and the interactions between parts.

The book prologue (Warren, 2022) frames the question of the conceptual and operational definition of MW, named in different ways: spontaneous thought, stream of consciousness, daydreaming, stimulus-independent thought, task unrelated thought, etc. *Which one best suits mind-wandering?*

Starting from this question, Warren (2022) considers the debate on its definition in cognitive science.[4] She reports the first use of the term "mind-wandering" as a synonym of stream of consciousness (Pope, 1978) and stimulus-independent

[3] Reconsidering Giunta (2014)'s idea on flexibility as lines and circles.

[4] Here, we find two main approaches: dynamic and family resemblance. The former propose that mind-wandering is a member of a family of spontaneous-thought phenomena that must be studied to understand how its states, arise or change over time, **distinguishing it** from, for example, rumination (see Christoff et al. 2016, 2018), and linking mind-wandering with two concepts: variability and constraints. "Some studies have started investigating this dynamic dimension of MW, introducing measure of the degree of freedom of movement in thought (i.e., level of constraints on thought as it unfolds over time) (Smith et al., 2018) and examining its relationship with the other, content-based dimensions, as task-unrelatedness and stimulus-independence Mills et al. (2018) (Pelagatti et al., 2020, p. 3). The issue of the dynamic of MW is also addressed, in a more temporal-based perspective, in the process-occurrence framework, proposed by Smallwood. According to this proposal, any comprehensive account of Mw is expected to explain when and why MW occurs, that is which processes and events control and prompt the initial occurrence of MW (onset) and how MW unfolds over time, that is which processes sustain MW over time (maintenance). In order to understand how the mind wanders, we need to identify and distinguish between the onset (the so-called process of ignition) and maintenance" (Pelagatti, p. 2).

The Family Resemble Approach doesn't accept a definition because "no single definition can capture all the facets and subtleties of mind-wandering, and neither logic nor empiricism can select among them. Thus, they propose defining mind-wandering as a multidimensional and **fuzzy construct,** encompassing a family of experiences with common and unique features" (Seli et al. 2018a, b).

thought, reminding the reader how much of the literature on the subject stems from Antrobus (1968). Warren (2022) seems to criticise the position that departs from the theory of information processing, where MW is considered a process that hinders and reduces the capacity of perception, processing and retention of the main stimulus. Our author, like William James (1890), prefers to stress the dynamic nature of MW: "To James, a perching represented a mental state including contents such as imaginings, worries and inner speech, whereas a flight represented the 'movement' from one mental state to another" (Christoff et al., 2016, p. 1), and associates it with mental travel (Corballis, 2015) and spontaneous thought. In this chapter, the reader can perceive the human uniqueness where MW is involved in "autobiographical memory retrieval, envisioning the future, and conceiving the perspectives of others" (Corballis, 2015). Hence, the importance of "episodic simulation" appears in relationship with creative processes, so the person is able to remember events and experiences and to imagine novel scenarios and situations. Warren believes that the universe of humans is full of stories, not of atoms, and MW is fundamental for storytelling and creativity where generation of ideas would be more highly spontaneous. However, Warren (2022) offers to the attentive reader some elements for a pedagogical reflection: she structures the chapter on the idea of spontaneity and creativity (Warren, 2018). Creative thinking is composed of a spontaneous part, linked to MW, and a critical one. The educator's purpose is to make sure that the creative process is not subjected to critical scrutiny before making room for MW. She underlines how the role of the adult must be to accompany the child in this part of the creative process, which is an expansive phase, without forgetting the critical aspect we were talking about. In this, she demonstrates how the educator's and teacher's job is to *take care* of children's ideas, thoughts and processes as if they were treasures.

The Lines

In the first part of the volume, there are trajectories of knowledge development on MW, the "lines", which are sometimes tangent to the "circles". That is, they have points that touch upon the chapters in the second section (Fig. 1.1).

Pepin and Lafont ("How and Why our Mind Wanders?") start analysing the concept of "attention", one of the most misleading and misused terms in cognitive science. From our authors' peculiar perspective, the chapter offers an overview on attention and MW. It introduces the topic showing how theories of attention evolved from the early sequential models of information processing (Antrobus, 1968) to more flexible and interactive models with parallel streams specialising in different forms of perceptual analysis, interactive cycles of processing and re-entry of earlier levels and cognitive neuroscience approaches (Treisman, 2009; Driver, 2001). The authors' theoretical reconstruction shows how avantguard or "embryonal ideas" on attention were already in the air even before cognitive neuroscience developed them.

Fig. 1.1 Holly BF Warren (2022), private collection, Milan, Italy

Initially, the authors describe how humans utilise selective attention to improve their confidence level in confusing situations, such as the so-called "cocktail party effect".[5] With Broadbent's (1958) "early filtering theory",[6] where the brain temporarily retains information about all stimuli but the information fades, unless attention is turned quickly to a particular memory trace, Pepin and Lafont want to stress the shift in attention research towards the interaction between psychology and neuroscience:

> The attempt to link physiology and psychology can be disastrous when it is premature. [...] But it would be equally disastrous to go on forever treating the brain as an abstract and ideal construct having no biological reality. (Broadbent, 1958, p. 447)

The "filtering theory" is used to introduce Kahneman's (1973) model of a limited pool of resources or "effort" to produce explanations that relate not only to psychological but also to neural processes.

[5] The "cocktail party effect" describes the brain's ability to focus on only one auditory stimulus while filtering out a range of other stimuli. For instance, a partygoer can focus on a single conversation in a noisy room.

[6] As referred by Pepin and Lafont, we use the term early theory because others changed it. Consider Treisman's "attenuation" modification of Broadbent's theory where he proposed that the filter merely attenuated the input rather than totally eliminating (Park & Lee, 2000).

The two authors are closely interconnected. Broadbent's theory is based on the computer metaphor of the mind. It is one of the first theoretical accounts to relate psychological phenomena to information processing concepts from mathematics and computer science. The computer metaphor stresses the analogy between the human attentional limits and the limits of central processing units in computers. In accordance with this view, Kahneman (1973) showed that a secondary task was impaired when combined with a primary task because resources were limited and these two tasks were unlikely to share the same brain networks:

> According to the Kahneman's model, the performance obtained following the success of a cognitive task depends on three factors: the amount of cognitive resources required to complete the task, the amount of available resources and the way resources are distributed (Kahneman, 1973). The amount of resources required to complete a task generates a cognitive load which varies with the type and the difficulty of the task. (Pepin & Lafont, 2022, p.)

Another element in Kahneman's model was the effort connected with attention. To illustrate this point, he gave an example taken from the school setting: "the schoolboy who pays attention is not merely wide awake, activated by his teacher's voice. He is performing work, expending his limited resources, and the more attention he pays, the harder he works. The example suggests that the intensive aspect of attention corresponds to effort rather than to mere wakefulness" (Bruya & Tang, 2018, p. 4).

Pepin and Lafont's (2022) exploration continues with the description of brain networks necessary for human attentional capacity: ventral attentional network (VAN), dorsal attentional network (DAN) and default mode network (DMN). In particular, they emphasise the role of these networks related to the occurrence of mind-wandering in individuals:

> Default mode network is not only activated during the vagrancy of thought (Stawarczyk et al., 2011) or when we think of something that is of personal importance (Gusnard et al., 2001), but its activation is found to be anti-correlated with that of the brain regions recruited during external sensory processing (e.g., primary visual and auditory cortex as emphasised by Smallwood et al., 2008). Thus, when we think about something else, the activity decreases in regions of the occipital cortex involved in perceptual processing (Gorgolewski et al., 2014). This means that we cannot process information from the outside world and stay focused on our thoughts at the same time. This may seem obvious to anyone who has experienced mind-wandering. However, this is a neurological proof of how our attention works and it sustains models of attention. (Kahneman, 1973; Wickens, 2002; Pepin & Lafont, 2022; p.)

Pepin and Lafont (2022) describe how the sophisticated dynamical patterns of activity emerge spontaneously across cortical and subcortical structures, but in particular, they stress that there is a different neural activation when a subject is engaged in some task, in the presence of external stimuli (task-evoked) and when the brain is at rest and external stimuli are weak or absent (mind-wandering).

By considering MW a first shift of attention from the outside world to personal thoughts and the maintenance of attention on the train of thought to protect the internal experience also known as perceptual decoupling (brain at rest), the authors wonder about MW costs and benefits in light of its positive or negative aspects in

relation to its emotional contents (positive or negative), to the activity to be carried out and to the context.

In the conclusion, the four main themes on mind-wandering emerge: temporality and emotion, intentionality and consciousness. All topics are connected with the educational setting, but we believe that this first chapter helps the reader to reflect on other aspects of the learning process. Pepin and Lafont (2022) suggest the idea of limits. Man has limits. Mind-wandering makes us human because we cannot control everything and we are governed by the laws of salience by which we are oriented/orient ourselves towards what we perceive as most motivating, interesting and useful at that given moment. In the final analysis, what is the purpose of education? To disclose the human in us, isn't it?

After all, in every historical period, man has discovered his limits but also his great potentialities: let's consider for a moment the role of passions in the Middle Ages. They had to be repressed because they had a negative connotation. In modern times, we have rediscovered their relevant role in learning processes and, more generally, in education.

In the second chapter of Vannucci, Pelagatti and Marchetti, the narrative focuses on the description of the most important studies on mind-wandering in adolescence, an age scarcely investigated by literature on mind-wandering.

According to the authors:

> the multiple emotional, social and cognitive changes characteristics of the life phase of adolescence makes young people vulnerable to psychological distress and mental health problems (such as depression, see Marchetti et al., 2016) but the association between MW and both negative affect and psychological distress in adolescents may have important implications, not only at a theoretical level, but also for designing intervention to promote psychological well-being. (See Smallwood & Andrew-Hanna, 2013; Vannucci et al., 2022, p.)

By considering adolescence a "critical period for protracted maturation of the frontal lobes and brain maturational changes that continue into early adulthood to play a crucial role in attentional mechanisms, especially in sustained attention and executive functioning", Vannucci et al. (2022) present the state of art on the topic and on cognitive attentional control in adolescence.

The relevance and pervasiveness of attentional problems are a major concern in educational contexts (for a review, see Polderman et al. (2010)) and psychopathology. In these particular fields the paper reconsiders in-depth Vannucci et al.'s (2020) elaborations that examined the association between trait levels of mind-wandering in daily life (deliberate and spontaneous mind-wandering) and depressive symptomatology, considering the differences in relation to age- and personal-oriented approach. The chapter maintains a strict distinction between deliberate and spontaneous mind-wandering (Seli et al., 2016) and underlines the importance of motivational dispositions in students. This confirms Klinger's current-concern hypothesis (Klinger, 1971, 2013; Klinger et al., 1973) where mental life is attracted to personal concerns, and, especially when the external world is relatively uninteresting and the circumstances are unfavourable for goal-directed behaviour, the mind turns inwards and starts wandering and the thoughts reflect the goal pursuit or associated contents.

Vannucci et al. (2022) conclude their chapter by suggesting the necessity to give a clear operational definition and to "capture the complexity of mind-wandering" through a multidimensional approach in particular if we consider how the contents and the context in which mind-wandering emerges are determinant for its relation to other cognitive variables (including pupil size) (Pelagatti et al., 2020; Konishi et al., 2017; Binda & Murray, 2015). This chapter is especially interesting because it introduces the reader to the methodological questions of the next section: the circles. It is a kind of tangent to the circle on the theme of the task; it strikes us for the attention given to the issue of well-being in adolescence and in school.

Starting from the idea of MW as a process observable in behaviour, a third chapter entitled "Mind and Body: The Manifestation of Mind-Wandering in Bodily Behaviourism" stresses the impact of MW on the perception-action cycle (Fuster, 2002, 2004):

> Perception of external stimuli is attenuated during mind wandering and, therefore, predictions and actions become more inaccurate or less efficient. In addition, mind wandering affects the body in other ways: one's posture might change, and the change in mental state might be reflected in facial features. Interestingly, there are also specific non-instrumental behaviors, such as fidgeting, that are associated with mind-wandering, suggesting that mind-wandering not only changes how the body interacts with the environment but also that mind-wandering is (at least to some extent) embodied. (Dias da Silva et al., 2022a, p.)

The chapter draws attention to instrumental and non-instrumental behaviours often forgotten in the educational field. On the contrary, it could be useful for teachers to be provided with tools (observations of instrumental and non-instrumental behaviours) to detect when mind-wandering takes place in the context of perception and action. The authors discuss its disruptive manifestation in bodily behaviours associated with intentional and attentive actions, linking MW with non-instrumental bodily behaviours. The findings suggested that there is a degree of decoupling perception of the external environment and bodily actions during MW. In the chapter, two experimental conditions are reported, *mind-wandering during a forced-choice reaching task and a tracking task*, where the movements of the hand appear to be more erratic and less variable hand movements with a reduced efficiency on the task. The same is indicated for eye movement and voice pitch. However, the chapter is also focused on non-instrumental behaviours such as fidgeting and facial features, the embodied manifestations of MW. Furthermore, this information can be of interest in the studies on intelligent tutoring systems.

At this point, the reader finds the idea of MW manifested in an exploratory off-task state, embodied in fidgeting, doodling and humming, serving to determine the next attentional state. The chapter closes with a brief analysis of a computational model of mind-wandering to be necessarily integrated with bodily behaviours. They wrote:

> In general, the computational models of mind wandering focus on simulated behaviour in terms of the trade-off between accuracy and speed. As we have seen throughout the course of this chapter, our behaviors while performing a task can be more complex than reaction times and accuracy alone in that mind-wandering is associated not only to a change in mag-

> nitude or the variability of any one type of bodily behavior, but rather to a systematic co-variation of bodily behaviors. (D'Mello et al., 2012; Dias da Silva et al., 2022b, p.)

Re-Organizing One's World. The Gestalt Psychological Multiple-Field Approach to "Mind-Wandering" closes the section on the lines and offers a new approach on mind-wandering as a reorganisation of the total phenomenal field of perception and experience. The author discusses the "conditions, implication and potential applications of Gestalt psychological multiple-field approach".

In particular, it offers a new vision of consciousness, a description of the mind-wandering phenomenon (*where it primarily consisted of one phenomenal world, divided into one phenomenal ego and its phenomenal environment, now a second world separates itself from this one world, which is also divided into a phenomenal ego and a corresponding phenomenal environment. This second world is embedded in the first and is more or less closely interrelated with it. This is what happens in the mental processes that are conceptualised, with positive or even negative connotations, under such diverse terms as mind-wandering, daydreaming, imagining, fantasy travel, attention deficit disorder, dissociation and so on*) and the main features on the Gestalt theoretical approach to "mind-wandering".

Starting from the MW state, the in-depth analysis of the author on the ideas of consciousness, total field, experience and applications in the therapeutic field makes any editor's explanation reductive. It seems more appropriate to write, as if this were the leaflet of a drug: "We recommend reading it".

The Circles

In this section, we find the following topics collected in three circles: the task and the measurement of mind-wandering (first circle), the intervention on forms of maladaptive mind-wandering (second circle) and creativity (third circle). The knowledge that develops therefore seems to return to itself, reflexively. In particular, the second and third circle attempt to find a point of convergence, describing how cognitive, socio-relational and socio-affective dimensions are integrated during the learning processes (Fig. 1.2).

In the chapter "Extended Minds and Tools for Mind Wandering", Gozli (2022) points to the lack of an analysis of the representation of the task (Metzinger, 2017) in experimental studies used to analyse and describe mind-wandering. A Autobiographical and literary examples (on writing and painting) are used to introduce how the methods of experimental psychology and cognitive neuroscience could be viewed as media of thought and communication. In particular, the methods for the study of mind-wandering are themselves cognitive tools that limit the way researchers think about MW. According to Gozli, perceptual decoupling is an example of an idea on MW that results from a bias built into methods of research. Generally, the role of experimental tasks as the engine of data production in mind-wandering studies has resulted in the recognition that research participants might

Fig. 1.2 Holly BF Warren (2022), private collection, Milan, Italy

occasionally disengage from tasks (Callard et al., 2012; Gozli, 2019). This has resulted in the emergence of research on MW which begins by considering MW a deviation from task performance and sustaining the perceptual decoupling (Callard et al., 2012, 2013; see also Christoff et al. 2018). This is the task-switching approach. Alternatively, Gozli (2022) proposes a style-based approach where mind-wandering is a style of engagement in another type of task (e.g. daydreaming). Gozli's questions can go beyond whether participants are disengaged, and address how they are actually engaged. We can ask how they might be observing, imagining or thinking differently in the same situation (Tateo, 2020).

In summary, in accordance with Vannucci et al. (2022), Gozli (2022) questions the main theories on spontaneous cognition (such as the inhibition and reduced cognitive resources theories of ageing) showing how task difficulty, consciousness, task interest and amount of current concerns may contribute to MW heterogeneity. Furthermore, Gozli suggests a style-based approach showing how this leads to a different interpretation of the phenomenon. It means to consider the possibility of a *hierarchical goal representation* (multiple-goal representation in Metzinger's idea) but also to distinguish between persistence and flexibility, developed by the researchers. Gozli's chapter creates a bridge with Dias, Postma and Faber's chapter: "Windows to the Mind: Neurophysiological Indicators of Mind Wandering Across Tasks". Gozli's analysis on tasks and the stress on the discrepancies observed across studies in addition to or in interaction with task demands reflect on neurophysiological indicators of mind-wandering across tasks (Dias et al., 2022b). They highlight subjective and objective measures of mind-wandering, revealing how the former (questionnaire, online self-reports, offline self-reports[7]) can be limited. For instance, they can have a low ecological validity and disrupt the natural flow of a task or

[7] The subjective self-reports are critically dependent on meta-awareness.

process. Triangulation of self-reports with behavioural and neurophysiological measures (e.g. eye tracking and EGG) can provide a more comprehensive research method of MW analysis. However, what strikes the reader is the sluice where Dias, Postma and Faber suggest applying research on MW in the context of intelligent tutoring systems to generate predictive models by means of machine learning (i.e. online lecture).

Surely, from the pedagogical point of view and from the research methodologies in the educational field, this chapter and the following ones refer to a need to identify methods and knowledge capable of interacting profitably with educational practices, and, in particular, they seem to remind us how too often a line of research in education is terminated with a change of fashion, or a change of paradigm, not because the problem has been solved (Hargreaves, 2007). However, the orientation towards triangulation and mixed methods shows how we cannot only anchor ourselves on the concept of effectiveness in schooling but we must always define "for what". In short, it is necessary to remember that at school there isn't only learning but also other dimensions such as autonomy, self-esteem, and well-being to which this second circle seems to refer (Olson, 2004; Chatterji, 2004).

The second circle is about intervention in educational settings. The first chapter of this section is "Non-invasive Brain Stimulation for the Modulation of Mind-Wandering". Here, we find a well-argued discussion on current direct stimulation techniques on mind-wandering and the description of non-invasive brain stimulation methods, in particular a novel neuromodulatory approach, *auditory beat simulation (ABS)*, to modulate mind-wandering and meta-awareness. The authors start with a short introduction on non-invasive brain stimulation techniques (magnetic and electrical ones) to treat auditory beat stimulation, a promising new method to safely and reversibly modulate cognitive processes. The method consists of applying two types of auditory beats: binaural and monaural. It has a relevant impact in individuals that exhibit a greater tendency to mind-wander.

Ergas' (2022) position on MW – an autonomous dimension of mind in which we do not control neither our actions nor our mental experiences – argues that we are hardly conscious agents. He suggests solving this problem through contemplative practices. According to Ergas, the agency of an individual has a fulcrum in attention, not in thinking. MW represents a case of hypo-agency and disintegration that is pervasive in our life (it takes the mind away from being fully invested in the present moment of embodied existence). MW is a state of mind of which we are *not* the agents. The fact that this phenomenon is so pervasive shows that students are not the integrated beings that school curricula speak of:

> Looking at students from an external gaze as integrated subjects does not grant us with enough understanding of agency. Inner experiences in which we supposedly will do one thing and do another, suggest first, that it might be more helpful not to think of students as integrated beings and acknowledge them as complex and disintegrated subjects. Second, it suggests that if education does assume agency and aspires to cultivate it, it needs to delve more deeply into the moment-to-moment processes concerned with agency that are associated with the depth of these inner complexities, so that it can indeed cultivate such agency if this is possible. (Ergas, 2022, p.)

Through the words of James (1995) and Holt (1995), Ergas shows us how difficult it is to talk about full agency and MW helps us to see it as a conundrum. Attention and agency are two faces of the same coin. All the curricula that think of the student as an integrated subject make no sense, but those that think of him as a human being, in need of being aware of what is happening in his own mind, make perfect sense.

Ergas' series of examples and suggestions on contemplative practices (i.e. an experiment on a form of mindfulness practice), used by the author with his students to enhance their attentional faculty, make the chapter even more interesting and rich in ideas for practitioners. He emphasises how essential it is to strengthen our attentional faculty to develop agency, and for this reason, contemplative techniques come to our rescue, to sustain the focus of attention on particular objects.

The contemplative practises are then perfectly described in Lars Didriksen's chapter, "A Contemplative Perspective on Mind-Wandering", where they are used to alleviate some negative effects of mind-wandering in health and educational settings. In the "Introduction", Didriksen (2022) retraces the main features of maladaptive mind-wandering: rumination, worry, anxiety and self-referential processing not only in clinical but also in daily activities. Starting from dissatisfaction (*Duhkha-samudaya*) and suffering and basing them on the idea of attachment (to the experiences that we don't want to end), Didriksen indicates contemplative practice as a means of stopping them. The mental creation of preconceptions limits our responses, and, on the contrary, zen meditation and mindfulness could promote the *shoshin* or a beginner's open mind. Didriksen's main idea is an inner transformation based on awareness and attention and a regulation of mind-wandering, "Paying attention in a particular way: on purpose, at the present moment, and nonjudgmentally" (Kabat-Zinn, 2013; Rogers et al., 2018; Xu et al., 2014).

Thus, he describes two distinct clinical programs: mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT). In the section "Biomarkers", he also offers a psychophysiological analysis that confirms how these practices modify our mental processes. The two programs, in particular, teach how meta-awareness helps the practitioner catch signs of changes to reach a mental and physical well-being in time. They reduce past- and future-oriented thoughts and reoriented attention to the present moment, the here and now moment.

A new perspective on the contemplative practices, expressed in the two previous chapters, is offered in "Mind Wandering and Emotional Processing in Nondirective Meditation". Here, the contemplative practices are used to facilitate MW and default network activity that implicate emotional processing. The reason for this contro-intuitive position at this point of our book introduction is "If mind-wandering were only negative, how would it have survived millions of years of evolution and have still been such a widespread trait in human beings?" Thus, in the chapter, Halvor Eifring (2022) looks "at one specific function of mind-wandering which is more rarely discussed in the research literature, but which turns out to be quite important: **emotional processing**". In fact, Xu et al. (2014) demonstrate, through fMRI, how non-directive meditation facilitates MW and activates the default mode network and other brain areas associated with memory retrieval and emotional processing (based on information and therapeutic processing of emotions). He wrote:

> One important feature of nondirective meditation is the *relaxed use of attention* involved in the free mental attitude, as implied by its effortlessness, its open and wide-angled nature, and its acceptance of digressions. This mode of attention facilitates an increased amount of *mind wandering*. This, in turn, creates opportunities for the retrieval of *episodic memories* that have been suppressed or relegated to the periphery of consciousness. Since these memories are often emotionally charged, their retrieval implies the resurfacing and *processing of emotions* that have not in the past been processed in a fully satisfactory way. (Eifring, 2022, p.)

This chapter is a sort of bridge with the last circle on creativity.

In fact, Böttger and Költzsch (2022) in "The Secret Powers of a Wandering Mind. Underestimated Potential of a Resting State Network for Language Acquisition" move to other topics: personal development, creativity and acquisition of new knowledge. Thus, the third circle on the positive side of mind-wandering takes shape. The two authors treat the connectivity between the emotion network, the salience network and the default mode network, indicating the functional importance of resting states of the brain (see Raichle et al. 2001). According to them, when the three brain networks are coordinated and co-regulated, humans can operate well in the world and take advantage of learning opportunities due to the fact that they contribute to social, emotional and cognitive functioning. In particular, the perspective and predictive brain, DMN, generally connected with mind-wandering, is able "to facilitate flexible self-relevant mental explorations – simulations – that provide a means to anticipate and evaluate upcoming events before they happen", so that the disengagement from current situations allows us to deal with imminent problems of the future, developing greater personal relevance and intrinsic motivation regarding the situations. According to Pezzulo et al. (2021), this has two imperatives: maximising the accuracy of mental explorations (to fit data) and minimising the complexity of reality (to avoid overfitting). In brief, mind-wandering increases accuracy and favours the reduction of complexity.

Furthermore, the chapter is inserted in this section because it considers mind-wandering a self-referential thought with similarities with the creative process. In this respect, the incubation stage is of significance: creative ideas are incubated, while the subjects are engaged in completely different tasks. This has an implication for foreign language production when the student constructs hypotheses about rules of the use of it, constantly tested and modified:

> Considering cognitive activities connected to the activation of the DMN, e.g. introspective or self-referential thought, emotional processing (Broyd et al., 2009), spontaneous cognition, or predicting possible actions (Raichle & Snyder, 2007), there is a link between these implicit processes and language acquisition related processes such as self-correcting and self-reflecting, unconsciously planning of the speech action, expressing personality through certain choice of words and expressions, or decision making how to say what to whom. (Böttger & Költzsch, 2022, p.)

The suggestion offered at the end for optimising the learning environment indicates how a concrete comprehension of mind-wandering is necessary to overcome the long-standing belief in Western culture that links attention to effort in an all-or-none manner. On the contrary, attention is graded in nature (Shad et al., 2012), and

optimal learning environments include sustained attention, flexible planning, exploration and discovery, followed by self-monitoring and meaning-making processes.

Developing and expanding the positive and creative side of mind-wandering, González, García-Huidobro and Fossa in the chapter "Is a Wandering Mind an Unhappy Mind? The Affective Qualities of Creativity, Volition and Resistance" are interested in proposing the unexplored position on mind-wandering. With the intention of generating an integrative framework of consciousness, the authors introduce the concept of mind-wandering as an affective expression, which extends to the processes of creativity, volition and resistance as inter-functional connections of thought (see also Fossa et al. 2019).

Mind-wandering is a complex cognitive-affective phenomenon in constant relationship to other functions of the psyche: volition, imagination, thought, language and memory. What is generally considered a task-unrelated thought is seen as a process by which attention is oriented internally through a neural mechanism of suppression that inhibits the focus on external information (Villena-González, 2019), it is linked to an individual's motivations (Smallwood & Schooler, 2015), along with the person's present concerns and goals (Vannucci & Agnoli, 2019). These considerations are also facilitated by the introduction of the developmental psychology concept of the continuum in thought. As also expressed in Fossa (2017, Fossa et al. 2019), this opens the doors to a new approach towards the topic in terms of inner speech, problem-solving and creativity:

> the expressive dimension of inner speech is a manifestation of the deeper states of consciousness, that is the expressiveness of the volitional sphere- motivation that resonates in our interior in the form of condensed experiences of images, thought and affections. (Fossa, 2017, p. 325)

In the "era of mind-wandering", the authors criticised the traditional notion of mind-wandering as a task-unrelated thought preferring the unguided thought, due to the severe limitations of this approach: scarce consideration of the dynamics in MW episodes and other intermediate forms of it, absence of explanation on how its content can be related to a main task and excessive emphasis placed on the connection between a shift in attention and mental wandering (i.e. there could be a simple switch between tasks). The advantage of their new approach is that it captures the dynamics of mental wandering and permits the establishment of a clear difference between it and other kinds of task-unrelated thoughts.

González et al. (2022) recognise two typical and contrasting variations of mind-wandering: spontaneous and deliberate. The first one is caused by a failure in the executive control of the attentional focus, and due to its non-intentional characteristics, appears suddenly in somewhat unsuitable situations. The intentional or deliberate mind-wandering refers to cases in which the focus of attention intentionally drifts away from the ongoing task towards internal thoughts. This refers to a process that happens under the individual's control (Vannucci & Agnoli, 2019) and that enables a certain kind of guidance in the content of thoughts, unlike unintentional mind-wandering. Spontaneous mind-wandering, in fact, generates costs – ADHD, OCD, self-reported anxiety, the tendency to act impulsively, distraction and other

attentional difficulties – while intentional mind-wandering is often associated with benefits due to the individual's capacity to control its occurrence: it has been shown to improve the ability to describe internal experiences, which in turn is a predictor of creative achievement (Villena-González, 2019; Agnoli et al., 2018). MW in this sense is useful to regulate the content of thought itself and the occurrence of mind-wandering in regard to the context (Villena-González, 2019). In relation to the above, "neurocognitive research has clearly shown that MW is far more than a failure to constrain attention to perception, but it is instead a remarkable mental activity, which entails complex higher-order functional and neural mechanisms" (Vannucci & Agnoli, 2019, p. 247). Thus, mind-wandering does not entail negative costs, and the authors insert a question on how exactly affective experience reflects on mind-wandering and vice versa. The answer is in the literature overview, showing the relevance of emotions in MW and, according to our chapter authors, in Vygotsky's perspective that advocates the existence of a volitional-affective tendency behind every thought (Vygotsky, 1934). In this manner, it is offered critical features of spontaneous thought and a more comprehensive and accurate conceptualisation of mind-wandering. Outside the homologated voluntary and non-voluntary kinds of cognition (Fossa et al., 2018), in this chapter, we discover the actuality of Vygotsky on this specific issue and two levels of volitive thought/action where spontaneous and deliberate thoughts represent the extremes of a continuum. Recapitulating Vygotsky's work, the chapter suggests that deliberate action or thought is not a single instance of volitive exercise, but the culmination of the process of volition to a higher-order or degree (Vygotsky, 1934). There is a continuum between the two polarities, spontaneous and deliberate, and we could also describe intermediate types of mental activities (Andrews-Hanna et al., 2017; Fossa et al., 2018). Furthermore, creativity becomes the expression of multiple inter-functional forms and takes place in a continuum between controlled and non-controlled forms of thinking. At this point, the chapter suggests another interesting aspect that could be explored in future research: the idea of mind-wandering as resistance to the psychological status quo. Thus, MW is a game, a resting state, a self-contemplation strategy, or a preparation or mental "rehearsal" that transgresses the temporal barrier into the future, as expressed by Böttger and Költzsch (2022).

Looking for a Structure That Connects: The Zigzag

In this book, we have seen "lines" of research and "circles" on specific themes (attention, age, disability, task and methodology, intervention methodologies and creativity). We have tried in the dislocation of the chapters to go beyond a summative reading of information and contextual relationships, but our interpretative choice has nothing to do with the truth. Bateson writes (Fig. 1.3):

> Let us say that truth would mean a precise correspondence between our description and what we describe and between our total network of abstractions and deductions and some total understanding of the outside world. Truth in this sense is not obtainable. And even if

Fig. 1.3 Holly BF Warren (2022), private collection, Milan, Italy

> we ignore the barriers of coding, the circumstance that our description will be in the words of figure or picture but what we describe is going to be in flesh and blood and action- even disregarding that hurdle of translation, we shall never be able to claim final knowledge of anything whatsoever. (Bateson, 1979, 27)

To wade so far, the conditions have not been created for a full understanding of this phenomenon, mind-wandering, but rather we have offered the reader "ways of perceiving" the phenomenon according to the different specific domains of knowledge. In this sense, the book allows us to reason about the fact that science "doesn't probes but explores" and almost always creates a difference that disturbs the quiet state of the system. This is the feeling that pervades the reader of the text and that could

disturb him because difference has always been an element of disturbance, so much so that often when the difference becomes uncomfortable for a pre-existing system of knowledge, a defence system intervenes that eliminates dissonances, creating a paradigm (a higher unity is sought that gives coherence to differences and contradictions). We will need a dialogical approach towards differences that recognises as constitutive elements of complexity in order to move forwards. We looked for a "structure that connects", paying attention to a generative epistemology that would build a zigzag dialectical scale of the knowledge processes that emerged: we tried to bring out the differences in the explanations of the phenomenon, to highlight the circularities, the hybridisations and mixtures between different disciplinary areas (domains) (Giunta, 2014). Something very clear has emerged: excluding the few studies on learning mainly related to reading-writing and purely of a psychological nature, there is a lack of pedagogical attention to mind-wandering in a systemic sense.[8] Obviously, we will not be able to fill a gap in the knowledge with a single book. However, we hope this may open a new avenue about mind-wandering research in education.

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[8] What happens when dealing with educational action? Let's take some trivial examples: what if the lesson is organised in a receptive manner? What happens if it is carried out in other ways (behavioural, guided discovery, simulative, collaborative, exploratory, metacognitive-regulatory)? Obviously to answer these questions, we need to focus on the contextual organisation of the component systems (e.g. metabolic, psychological-emotional, cognitive, social system) connected with mind-wandering and not on the components per se.

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Chapter 2
How and Why Our Mind Wanders?

Guillaume Pepin and Alex Lafont

Introduction

What is "to think?" One book will not be enough to grasp what is thinking in its tremendous complexity. "To think" means considering, evaluating. For some, without thinking the world would not really exist. Plato defined thinking as "the internal speech that soul silently has with itself." Thinking might therefore be compared to an ability, proceeding outside human consciousness allowing him to consider situations to reach satisfactory decisions.

What is "wandering?" It is the action carried out by the wanderer which is unpredictable and in a constant evolution. In its "metaphysical meditations," the French philosopher René Descartes said: "My mind is a wanderer which enjoyed to lose itself and suffer from being stuck inside the limits of truth." In its innocent definition, the wandering thought would therefore be pleasant and contrast to a limited, suffering maker reality. Descartes saw the mind as an entity with a full part existence and a proper willingness, able to disconnect from the outside reality.

Mind-wandering (MW) is therefore a state in which our thoughts are in a constant and unpredictable motion. It is an ability of our mind to switch from external to internal focus allowing us to temporarily free from the boundaries of the outside world. However, during MW, reading comprehension is impaired (Schooler, 2004; Was et al., 2019), and performances tend to drop down during a whole set of tasks (Smallwood & Schooler, 2006; Smallwood & O'Connor, 2011). Therefore, what is the point of these moments? What does it cost us and why is this sometimes beneficial to temporarily escape from the outside world? Additionally, why is this so difficult to prevent the wandering of our mind? To provide the beginnings of an answer

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to these questions, it is important to understand the concept of attention. In the next part, we will introduce different definitions and models of what is human attention.

Models of Attention

Attention is an ability of animals allowing them to prioritize or organize the research of information. Our attention guides us in a whole set of daily activities allowing us to dynamically interact with our environment. Because attention is not a simple concept, many studies have tried to explain how attention operates. Different theoretical models have therefore tried to conceptualize mechanisms underpinning the experimental results obtained in these studies and presented in the scientific literature over the years. In the 1960s, first researchers who studied this topic thought that attention might have a filtering function.

Is Attention a Filter?

Historically, part of the earliest models of attention sought to explain this phenomenon by imagining attention as an early sensory filter of information processing (Broadbent, 1958). A stimulus (e.g., sound) that is not of primary interest would be filtered to allow better processing of the relevant information. The processing would therefore be dedicated to the expected information. But the "cocktail party" effect moderates this binary vision. Let's imagine a mundane situation in which many people are in a room and chatting with each other. If we are focused on what a person at the other end of the room is saying, it is likely that we will process the words and thus understand the content of the speech rather than those from another discussion at the other end of the room. However, if one of the people in the crowd pronounces our first or last name, this particular word should, according to the Broadbent's model, be filtered, which will not be the case here. We were listening to our partner and focused on the discussion and not to our name that suddenly popped. Yet, we managed to hear precisely that element. This illustrates that the processed information are not always the expected ones, but those which are relevant to the individual. The processing of relevant stimuli is therefore not compatible with the model of Broadbent (1958). Several updates to this model have been proposed to respond to this problem by suggesting a later sensory filter. Treisman's (1969) model postulates that unexpected information is not completely filtered, but rather attenuated.

Is Attention a Pool?

According to Kahneman's model, the performance obtained following the success of a cognitive task depends on three factors: the amount of cognitive resources required to complete the task, the amount of available resources, and the way resources are distributed (Kahneman, 1973). The amount of resources required to complete a task generates a cognitive load which varies with the type and the difficulty of the task. The amount of resources available does not only depend on the individual's capacity for the task but also on the individual's characteristics (age, fatigue, etc.). Finally, the resource distribution system ensures the selection of the relevant information. Cognitive load can therefore increase when resources have to be mobilized or redirected (de Waard, 1996). According to this model, it is impossible to supplement additional tasks under penalty of seeing performance collapse or people disengage from the primary task.

However, it appears impossible, under certain conditions, to simultaneously process several information when it is sometimes impossible to perform an additional task despite the availability of resources. It is, for example, difficult to hold a banal conversation while carrying out mental calculations, even very simple ones. These two tasks theoretically do not exceed the capacities limitation of the individual, but individuals rather finish the conversation before calculating instead of doing it simultaneously. How can we explain this? How can we reconcile the constraints emanating from experimental research with these theoretical models of attention?

With these contradictions in mind, an update of Kahneman's (1973) model has been developed by Wickens (2002). In this revised model, attentional resources are not all the same but would have specific characteristics. These resources would be divided into a system made up of several pools. This multiple attentional resource model describes different types of resources that may be missing when two tasks requiring the same type of resource are performed in parallel. This model helps us to understand the mechanisms behind our difficulties in simultaneously writing or reading a text while having a discussion. Verbal attentional resources compete between these two tasks. To be efficient, we must prioritize them and perform these two tasks one after the other. Wickens' model works very well for almost all our daily actions. Nevertheless, this model, in which attention is a pool and resources are limited, only describes situations of overload. Indeed, this model correctly predicts the performances obtained when the task is too difficult to handle. However, what about situations where individuals have to perform a very simple task? In the previous model, there is no mention of underload situations which are also responsible for the drop in performance (Endsley & Kiris, 1995). In those cases, a large amount of attentional resources should be available, which would thus allow adequate or even better performance for the tasks proposed. Surprisingly, this is not what happens most of the time. Once again, it appears necessary to update this model of multiple resources in order to include cognitive underload situations and better reflect reality.

Manipulating attentional resources would have a cost (de Waard, 1996). Not having to handle too many resources for a task that does not require them would help individuals to save resources. In this model, it is the size of the reservoir itself which varies according to the characteristics of the task (Young & Stanton, 2002). The pool might shrink to roughly adapt to the cost of a task. Best performance for tasks would be achieved when all of the operator's resources are engaged (Lavie, 2010). This is why residual capacities can sometimes disrupt the fluidity in processing by directing resources to other operations, which interfere with the smooth running of the main task. The attentional pool adaptation to the demand of the current task will be done to a certain extent. Indeed, the attentional reservoir will not be able to fully compress or expand infinitely. If that were the case, we would have no trouble thinking about nothing for several minutes. It is very difficult for us to blank our mind even for 20 seconds. There is always a certain amount of available resources which, when the demand for the task is low enough, will be used by redirecting them toward personal thoughts or reflections. This is why the mind-wandering state fits within the framework of this model of malleable resources. Indeed, we often switch from external outputs to our internal world when cognitive demand is low in order to prevent underload and boredom.

Is Attention a Set of Cerebral Networks?

More or less recent researches have revealed that attention is biologically underpinned by a set of brain structures and networks. Together, these networks make possible our ability to process and prioritize the relevant information and allow us to organize our daily life. Specific networks are involved in processing external information, whereas others are dedicated to escape the here and now and sustain the mind-wandering state. The activity of certain networks could therefore provide information on the location of the individual's attentional focus and the degree of attention paid to the current task.

With aim of saving energy and being as efficient as possible, the brain does not have a lawless architecture. Besides being easily divided into several areas (e.g., frontal, parietal, temporal, or occipital lobes), each of brain regions has inner substructures and underpins specific cognitive and/or sensory processes. Visual information processing is located within the occipital lobe, whereas auditory processing mainly depends on the temporal lobe (see Fig. 2.1). Advances in neuroimaging recently provided a great avenue to deeply investigate the brain. At the same time, understanding how the brain regions communicate together has become increasingly obvious as everything we are experiencing in our daily life is dynamic. This conceptually gave birth to the idea of brain networks. By following this rationale, researchers have clearly demonstrated that distinct networks exist. Those networks would be more or less complex and might share same brain structures. Once again, technical advances, especially in functional magnetic resonance imaging (fMRI), allowed emphasizing several tangled networks. However, each network has a

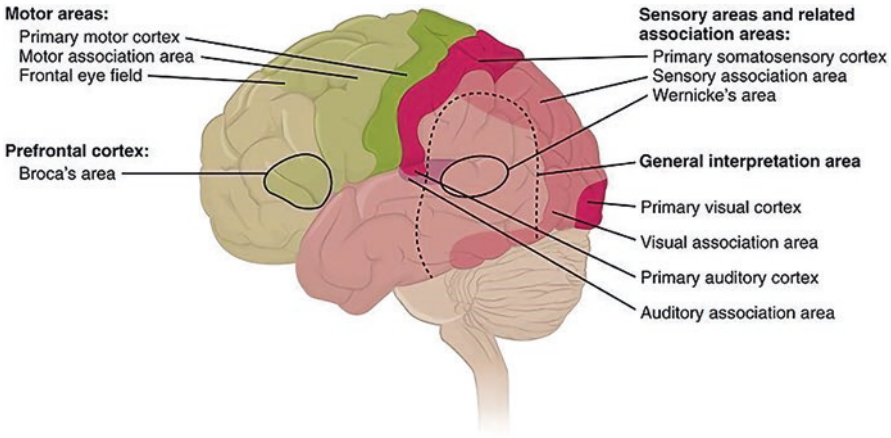

Fig. 2.1 Schematic sectional of the brain representing various areas responsible for sensorial processing

specific structure made up of substructures or brain areas. Those substructures are, most of the time, dedicated to the achievement of specific actions such as transmitting, processing, computing, and integrating electrical information. Subsequently, we will briefly describe two networks which are in charge of attentional processing: the dorsal attentional network (DAN) and the ventral attentional network (VAN). Afterward, we will discuss about the default mode network (DMN) which has been discovered more recently.

According to Corbetta and colleagues, there would be two distinct networks underpinning different needs in terms of attentional capacity (Corbetta & Shulman, 2002). First, the DAN is an attentional network mainly devoted to top-down processes, namely, goal-oriented. Together, the structures that comprise the DAN have a top-down influence on visual attention. That network has close ties with the VAN which is responsible for bottom-up processes with attention. The VAN also allows computing and weighting some information which come from sensory organs. This network is weakly activated during the top-down processing from DAN in order to keep the attentional focus on goals and the short-term visual memory and not to be distracted with irrelevant stimuli. By contrast, when goal-relevant stimuli suddenly pop, the activity of the VAN would increase which, in turn, would allow integrating new information. Therefore, the VAN is mainly devoted to the control of the attentional focus which is guided by sensory organs in order to orient the attention toward salient stimuli (Carretié et al., 2013). For an illustration of how these networks are distributed in the brain, see Fig. 2.2.

The DMN is not in charge of controlling or orienting attention. It is a particular network that has to be particularly considered when studying mind-wandering and more broadly inattention. This network underlies several aspects of cognition (Spreng, 2012) involved in semantic processing or information retrieval from

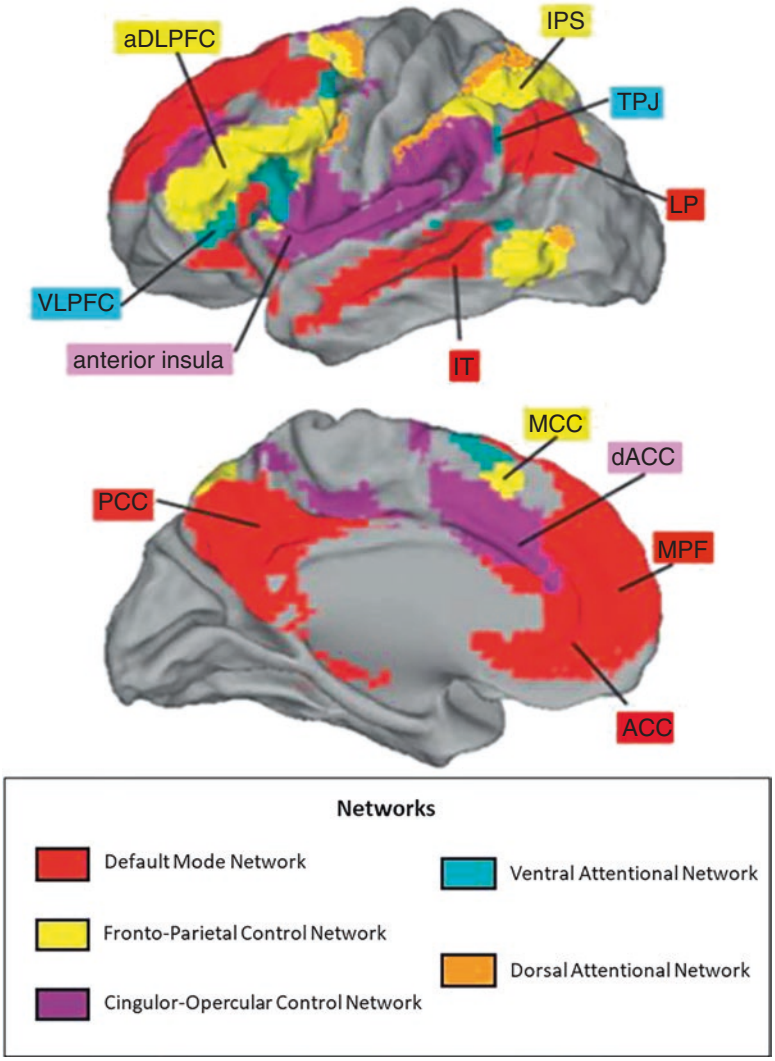

Fig. 2.2 Schematic sectional showing how attentional networks are disseminated in the brain

episodic memory (Rugg & Vilberg, 2013). This default network is more activated during resting states, when we think of ourselves (D'Argembeau et al., 2005; Kelley et al., 2002), when we plan personal events (Spreng et al., 2010), when we have emotional reflections (Engen, 2017), or when we imagine future or past events (Schacter et al., 2007). Neuroscience has provided tremendous proofs of the existence of such a network, and some authors have highlighted a high number of substructures composing it (e.g., Greicius et al., 2003; Raichle et al., 2001).

Default mode network is not only activated during the vagrancy of thought (Stawarczyk et al., 2011) or when we think of something that is of personal

importance (Gusnard et al., 2001), but its activation is found to be anticorrelated with that of the brain regions recruited during external sensory processing (e.g., primary visual and auditory cortex as emphasized by Smallwood et al., 2008). Thus, when we think about something else, the activity decreases in regions of the occipital cortex involved in perceptual processing (Gorgolewski et al., 2014). This means that we cannot process information from the outside world and stay focus on our thoughts at the same time. This may seem obvious to anyone who has experienced mind-wandering. However, this is a neurological proof of how our attention works and it sustains models of attention (Kahneman, 1973; Wickens, 2002). The activity of the DMN is thus roughly the opposite to that of the networks responsible for sensory processing, and this network turns out to be independent of the attention ones (Fox et al., 2005). Strong activation of DMN when individuals report daydreaming makes this structure particularly relevant for studying mind-wandering (Christoff et al., 2009; Greicius et al., 2003; Stawarczyk et al., 2011). In addition, the thickness of the regions related to the medial prefrontal cortex and the anterior cingulate cortex, structures belonging to the DMN, would be correlated with the occurrence of MW in individuals (Bernhardt et al., 2014).

What Is Attention?

In summary, these models show that attention is a complex function. Our attentional capacities are limited and attention can be depicted as a pool containing limited resources. These resources can be differently consumed depending on the characteristics of the current task. This is why it is difficult to write a message while holding an oral conversation, these two actions mobilizing the same type of resources (e.g., verbal). In addition, it appears that we are not able to react similarly to a sudden event regardless of how much demanding the task we are doing is. Indeed, the capacity of the attentional pool roughly adapt to the demand of the task performed. Nevertheless, the way we adapt to large variations in the task demand might impact our level of alertness and commitment, which would also be costly in terms of resources and could generate fatigue. In the context of learning, these characteristics must therefore be taken into account. Learning must be moderate over time and not deplete the attentional resources of individuals too quickly. Its difficulty must also be adapted and not present too great variations at the risk of seeing individuals disengage from the task.

Moreover, attention is underpinned by a set of brain structures that are activated preferentially according to what the individual is doing. These complex structures allow quickly processing expected and unexpected information permitting us to properly interact with our environment. Attention would act as filter by deleting information that is not relevant to the individual. In the case of learning, the environment is important. In a noisy setting, it is harder to stay focus because our attention would have trouble filtering all the irrelevant stimuli. This would also generate fatigue. We started to explain the mind-wandering state by showing that it is

underpinned by a set of different brain structures. In the next section, we will pay attention to what exactly is mind-wandering, what its daily characteristics are, and how to deal with it.

Mind-Wandering

Mind-wandering (MW) is defined as a shift in the content of thoughts away from the ongoing task toward self-generated thoughts and feelings also known as task-unrelated thoughts (TUTs). This definition, close to the one formulated by Smallwood and Schooler (2015), addresses the problem of attentional shift as well as its persistence known as perceptual decoupling. Perceptual decoupling corresponds to the capacity of the human mind to disconnect our attention from our perceptions, allowing thoughts and feelings to become the fundamental and central elements of conscious thought (Schooler et al., 2011). Therefore, there are two phases in the MW state: a first shift of attention from the outside world to personal thoughts and the maintenance of attention on the train of thought to protect the internal experience also known as perceptual decoupling.

In Everyday Life

Mind-wandering is a common phenomenon that everyone experiences on a daily basis. However, it is difficult to accurately estimate the probability of occurrence of this state. Firstly, individuals are not equal when facing MW; some experience it very often every day and others very little. MW tends to be more present in young people and children than in the elderly ones, but it seems that there is no difference between men and women (Burdett et al., 2017; Giambra, 1989, 1993). Fatigue, alcohol consumption, and psychotropic substances are likely to promote the emergence of this state (Kane et al., 2007; Sayette et al., 2009). In case we might doubt that MW arises in the cerebrum, it is also possible for a given time period to artificially increase or reduce the emergence of MW by stimulating areas in the brain (Axelrod et al., 2015; Kajimura & Nomura, 2015), and the thickness of areas are likely to predict the emergence of MW (Bernhardt et al., 2014). Moreover, the working memory capacity is likely to modulate the sensitivity of individuals to this state by increasing or decreasing the occurrence of MW depending on the kind of task people are asked to do (Kane et al., 2007; Levinson et al., 2012; Rummel & Boywitt, 2014; Pepin, 2018). Moreover, the mindfulness trait of an individual could lead to different level of MW: mindful people tends to have fewer TUTs in both demanding and undemanding tasks (Ju & Lien, 2018). Thus, we might not be equal when facing MW. Considering learning, some students may be susceptible to be more often inattentive because of their cerebral and personal characteristics, while others may have no trouble being focused for hours.

Characteristics of the current activity are also important to apprehend the occurrence of MW. A cognitively inexpensive task, whether it is straightforwardly easy, a repetitive task, or a familiar one, will generate more inattention than a more complex one which will require engagement and concentration (He et al., 2011; Kam et al., 2014; Dehais et al., 2020). For example, when driving a car, the emergence of MW increases with the practice of the activity (Yanko & Spalek, 2013) and more generally with the level of expertise (Cunningham et al., 2000; Smallwood et al., 2004). This could explain why a known journey (e.g., home-to-work travel) is likely to be more dangerous for the driver than a new one (Burdett et al., 2017; Yanko & Spalek, 2013).

It is difficult to be precise when quantifying the percentage of time we spend thinking about something else than our main activity. The occurrence of MW has been probed with different daily tasks such as a memory, reflection, reading, etc. Results obtained range from 25% (Kane et al., 2007; Spronken et al., 2016; Stawarczyk et al., 2013) to 40% (Yanko & Spalek, 2014), 45% (Ottaviani et al., 2013), and 47% (Killingsworth & Gilbert, 2010) up to more than 50% of the time (Kam & Handy, 2014). These differences can arise, as we have seen, from heterogeneous populations, heterogeneous experimental paradigms, different tasks, or even from different definitions given to MW. So, how can we properly estimate and limit the chances of mistaking the presence of MW? The only study that did not offer an ancillary task, but tried to measure the occurrence of MW in all of daily life tasks, is the one conducted by Killingsworth and Gilbert (2010). Several times a day, 2250 people from dozens of different countries (although 74% of the respondents were American) were sporadically stopped during their daily life and asked to report what they were doing. In details, they were instructed to assess the orientation of their thoughts (i.e., focused on the outside vs. internal world) and their time-related and emotional content (i.e., past vs. present vs. future-oriented and neutral vs. negative vs. positive). People reported that their attention was focused on something else than what they were currently doing for 46.9% of the time. Surprisingly, this result varies little with the type of activity performed, and each activity is performed with TUTs at least 30% of the time except making love (Killingsworth & Gilbert, 2010). This means that about half the time, individuals are not focused on their activity. By interrupting someone in his daily life, we have almost 50-50 chance to find him thinking about something else than whatever he is currently doing. Although people are not equally affected by MW, results obtained in this study reflect how much this state is regular in our daily life and that it should not be left behind when studying learning processes. For example, people tend to have more TUTs over the duration of a lecture when viewed in video format, while those who viewed it live did not (Wammes & Smilek, 2017).

MW might make us break a glass or miss a step on the stairs and, at worst, make us have a serious car accident. So, why does our mind escape from reality so often while we know the dangerousness of inattention? This takeover of our attention, without permission, may therefore seem astonishing. However, MW is very present in everyday life. The evolutionary approach leads us to think that, if a characteristic

has endured up till now and has not disappeared yet, it is because of its benefits for the individual. MW might not be an exception.

Benefits

Mind-wandering has many advantages. It helps us planning our lives by reminding us the appointment we had forgotten later in the day, resolving our daily problems, or building a shopping list during housework. Einstein even said: "Why is it I always have my best ideas while shaving?". How many scientific, artistic, or political ideas emerged when people were cooking, driving, or even in the shower or to the toilet? Indeed, these activities tend to be the most automatically performed (Killingsworth & Gilbert, 2010). Without constraint on our cognition, our mind tends to freely stray (Andrews-Hanna et al., 2017). So, to the question "why does not the mind stay perfectly focused on the tasks being performed, even on the most routine?" The answer could simply be that our minds can indulge in it and that our complex brains are not programmed to leave free resources in the attentional pool. Indeed, each time that we do nothing or we are performing an easy task, our minds drift away to self-generated thoughts, even if we are not aware of it. Reversely, when our mind is busy but our body has nothing to do, we tend to perform automatic and physical task such as playing with a pen or pacing in the living room during a phone call.

During MW, our thoughts become both the direct focus of our attention and the center of our conscious experience (Schooler et al., 2011). This might allow us to be more creative after performing a short period of automatic task (Baird et al., 2012) or to be more efficient in solving a complex problem (Abadie et al., 2013). MW appears to act in the background of the mind while the individual performs a secondary task. MW status would also allow us to organize our lives without having to actively think about it by planning future events or trying to solve our personal problems (Mooneyham & Schooler, 2013; Smallwood & Schooler, 2015). The MW state would also underlie important functions without which our lives would be very different: the possibility of extracting ourselves from the here and now, imagining other places and moments (Nyberg et al., 2010), and even the ability to infer what others think or feel (Frith & Frith, 2005). Others postulate that MW is essential for all creative thinking, which is the basis of language and any form of complex cognition. MW is also an easy and fun way to get rid of stress and boredom (Corballis, 2015).

The mind-wandering state would therefore be useful for individuals by allowing them to be more creative, escaping from their immediate environment, imagining other places and moments, or solving personal problems. However, by directing our attention toward our thoughts or our personal problems, we disconnect from the external environment. In turn, it would impact the performance of the primary task and therefore, the harmful effects of MW would emerge.

Drawbacks

By drawing in attentional resources, MW leads to poor performance in a multitude of everyday tasks (Smallwood & Schooler, 2006). It turns out that MW impairs comprehension during silent or aloud reading tasks (McVay & Kane, 2012; Schooler, 2004; Unsworth & McMillan, 2013). Driving a car requires collecting, processing, and encoding information. Obviously, given the risks of body injury, the risks of attentional dropout during MW are therefore even more damaging for drivers (Galera et al., 2012) as compared to silent reading.

MW would particularly degrade performance of tasks requiring supervision and immediate encoding of information (Ruby et al., 2013) which could be problematical in a learning context. This is also a reason why MW should be taken into account when studying learning processes so as to frame its effect as much as possible.

A Halftone State

As previously described, our attention tends to drift away from the task we are currently doing to our personal thoughts leading to a higher risk of error. Unfortunately, the reasons that keep our attention away from the task at hand are quite mysterious. As we have said, MW has an evolving role in planning, organizing, and solving our personal problems (Buckner & Vincent, 2007; Smallwood et al., 2009; Smallwood & Schooler, 2006); attention would therefore be devoted to what is the most relevant to the individual at any given time (Randall et al., 2014). Consequently, attention may shift to personal thoughts only when we need it and when the situation allows it (e.g., when the task is simple and can be performed automatically/easily).

Considering the aforementioned models of attention and given the characteristics of MW, it is likely that this state soaks individuals' attentional resources to feed internal trains of thoughts. During a learning exercise, the individual experiencing MW would therefore be less able to focus on the task or the speaker; his resources are no longer allocated to the main task but used to fuel his thoughts (Baird et al., 2011). He might think of what to do after class, how to relax, etc. The presence of MW might therefore cause learning difficulties because of the disconnection between attention and environment, what we previously described as perceptual decoupling.

Perceptual Decoupling

MW is a two-step state. A first drift of attention far from the task we are doing followed by the maintenance of attention protecting the new internal experience, called perceptual decoupling. Perceptual decoupling is a fundamental and essential

characteristic of MW. During this state, our attention is focused on our thoughts and/or our personal feelings. It corresponds to a disconnection of attention away from sensory inputs and perceptions (Schooler et al., 2011; Smallwood & Schooler, 2015). As we saw in the previous section, perceptual decoupling is maintained by the activity of different brain structures and more specifically by the default mode network. Other evidence of perceptual decoupling can be found by examining cortical activations of various areas in the brain. During MW, the brain activity in the cortical areas is reduced (Chaparro, 2015), meaning that information processing is more superficial when we direct our attention toward our thoughts as compared to the external world.

Perceptual decoupling reflects the dissociation between the individual and its immediate environment. In Treisman's (1969) attentional model, attention is seen as a filter attenuating irrelevant information. Perceptual decoupling could perfectly match the features of this filter: when individual focuses its attention on their internal world, its thoughts become the most relevant element. Information from outside is therefore attenuated so as not to disturb the flow of thoughts. During this phenomenon, people's visual exploration is reduced (He et al., 2011) and certain stimuli are ignored (Yanko & Spalek, 2014). This might be due to the deflection of resources to maintain the train of thoughts and the switch of activation between networks responsible for active attention (DAN and VAN) and the default mode network. Perceptual decoupling is a first explanation for the performance decrease associated with MW (Smallwood & Schooler, 2006; Unsworth & McMillan, 2013). But this state is not a simple reorientation of attention; the thoughts that are simultaneously generated must be fed to exist and persist. This is also why we don't have a lot of wandering thoughts while performing a difficult task; all the resources are allocated to succeed in the task. Otherwise, the lack of resources to perform the two tasks would generate errors and would get us out of MW by realizing that we are experiencing TUTs.

It turns out that characteristics of thoughts could be an essential factor in estimating their degree of disturbance, and part of the current research aims to explain these disparities. The content of our own thoughts refers to the message they generate. When we are in a certain state, in a negative mood, for instance, we will tend to think to different things compared with when we are in a more positive state. Our thoughts are as spontaneous as they can include a wide spectrum of features and content. The content regulation hypothesis carries the idea that the content of the thoughts and the experience lived by the individual will define the impact of this state on the performance of the task in progress (Andrews-Hanna et al., 2013; Smallwood & Andrews-Hanna, 2013). When considering MW, it should be noted that not all types of thinking are the same. There is a multitude of different types of thinking, which could be classified according to many characteristics based on the content of thoughts (temporality, intentionality, emotional valence, consciousness, purpose of thoughts, etc.). The next section will focus on some factors used to classify thoughts.

To Classify Thoughts

Temporality and Emotion

First of all, emotional content and temporal orientation of wandering thoughts are not random. Several researches made clear the existence of prospective and retrospective bias. These biases represent strong links between the temporality of thoughts and their emotional content (Smallwood & O'Connor, 2011). The prospective bias emphasizes that a majority of wandering thoughts are future-oriented (Berthié et al., 2015; Smallwood et al., 2009). This is explained by the fact that MW has a relevant function in planning and solving personal problems (Buckner & Vincent, 2007; Smallwood & Schooler, 2006). The proportion of future-oriented thoughts varies across studies, but seems to be around 50% of all TUTs (Baird et al., 2011; Berthié et al., 2015). This means that, on average, one in two thoughts unrelated to what the individual is doing is directed to future events. We saw that people tend to think to something else than what they are currently doing for around half the time. This would mean that you have one chance out of four to interrupt someone during his task while he is thinking of something that has not happened yet.

The proportion of past-oriented thoughts is around 12%, while present-oriented thoughts represent around 30% (Baird et al., 2011). Thoughts without temporal orientation would represent around 11% of thoughts (Smallwood & Schooler, 2015) and would be different from present-oriented thoughts (see Fig. 2.3). These might be philosophical thoughts or thinking about the spelling of a word, for example. Present-oriented thoughts are often amalgamated with the thoughts without

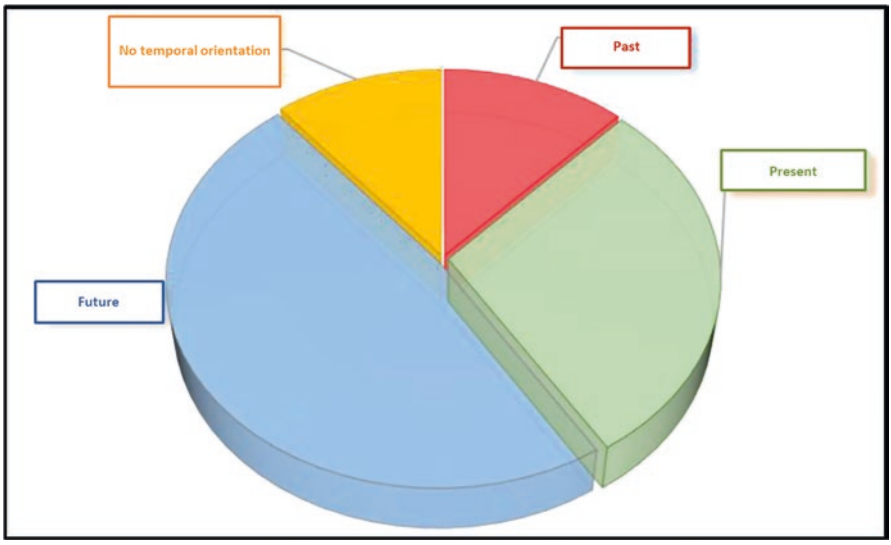

Fig. 2.3 Diagram showing proportion of temporally oriented thoughts

temporal focus which generates inaccuracies in the quantification of temporally oriented thoughts. Generally, thoughts unrelated to the individual's activity tend to be future-oriented and these thoughts tend to be positive (Ruby et al., 2013; Spronken et al., 2016).

Intentionality and Consciousness

Among all thoughts unrelated to the task at hand are "spontaneous thoughts," which supplant task-directed attention for unconscious and unintentional thoughts (Christoff, 2012). The group of "spontaneous thoughts" is not uniform and brings together, within it, the vagrancy of thought, daydreams, or even episodes of involuntary autobiographical recall. These thoughts are neither conscious (until the individual realizes it) nor intentional. In contrast to these thoughts that spontaneously burst into the mind of the individual, intentional thoughts unrelated to the main activity have been described.

Immersing ourselves intentionally in task-unrelated thoughts assumes that we feel able of performing two tasks in parallel. We feel confident enough to allow us to disconnect from the environment. Intentionality seems to be an important factor for wandering thoughts categorization. Indeed, intentional TUTs would not be underpinned by the same cerebral substructures as thoughts arising spontaneously. Indeed, coupling the frontoparietal control network with the default network (Golchert et al., 2017) would generate separate states (Smith et al., 2006). These two states appear to result from a particular brain function, underlying separate cognitive processes that could be the source of different degrees of interference with learning. In the same way, conscious and unconscious task-unrelated thoughts would involve different brain regions (Smith et al., 2006) and might have different impact on people, drivers, for example (Pepin et al., 2018).

Conclusion

At first glance, we might be tempted to put into perspective the harmful impact of mind-wandering during learning: it cannot be very dangerous to think of something else for a few moments. Actually, most of the time, MW has no negative impact. However, it can be problematic during certain activity such as driving or learning with various levels of negative effect and potential risk according to the task we are doing. We now know that MW impairs comprehension reading. Moreover, a more difficult task, as it is often observed during some learning stages, is associated with more MW (Soemer et al., 2019). By drawing into working memory resources, MW prevents the ability to refresh information from the outside world (Kam et al., 2014), and investigating the presence of MW during learning processes appears to be a significant issue.

Investigating the characteristics of MW and its functioning appears as something exciting and primary to better understand performance in a large set of tasks. In the previous sections, we have seen that MW is a particular state since it is experienced by everyone on a daily basis. It has been shown that the degree of interference from MW would be different depending on the content of thoughts and the context in which it occurs. It turns out that not all thoughts seem to have the same degree of interference with the individual's main activity. Thoughts related to the organization of our daily life could thus be more or less disturbing according to their emotional content (positive or negative) or their temporality. Mentally building a shopping list or thinking of not forgetting to pick up the kids from school might not have the same impact. In the same vein, for kids who tried engaging in learning processes, thinking about the yesterday test or the football game in the evening may not prevent learning in the same way. Moreover, we know that kids tend to experience more MW than the older one, raising even more the question of the role of this state for them.

A section of contemporary research seeks to dissect these characteristics to study the impact of these thoughts on humans, using tools such as electroencephalography, eye tracking, heart rate analysis, etc. In the future, perhaps we will be able to facilitate learning by orienting its content so as to limit its presence or even prevent MW during learning phases so that kids and more broadly people will not suffer its harmful effects.

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Chapter 3
Mind-Wandering in Adolescents: Evidence, Challenges, and Future Directions

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First studied by a handful of researchers almost 50 years ago (Antrobus et al., 1966; Klinger, 1971; Singer, 1966), in the past two decades, mind-wandering (hereafter MW) has received widespread scientific attention, with a steep rise of publication numbers in psychology and neuroscience. To date, several studies have been carried out on the functional and neural mechanisms underlying MW (for a review, see Smallwood & Schooler, 2015) as well as on age-related differences in the experience of MW (see, for a review, Maillet & Schacter, 2016).

Moreover, recently, two important conceptual and methodological advances have been reported in the field of MW: on the one hand, more fine-grained conceptual definitions of MW have been proposed and successfully applied in the studies (see Pelagatti et al., 2020 for a discussion on this topic); on the other hand, researchers have recognized the complexity of this phenomenon and its heterogeneity, and important distinctions between different kinds of MW have been introduced (e.g., spontaneous vs. deliberate MW, see for a review Seli et al., 2016a).

Surprisingly, to date only a few studies have investigated the phenomenon of MW and its correlates in adolescents, although the number of publications on this topic is rapidly increasing. Some of these studies have focused on MW as a state, directly tied and measured during a task in a laboratory setting (e.g., Stawarczyk et al., 2014), whereas others focused on MW as a trait/dispositional tendency to do MW in everyday life (Vannucci et al., 2020; Mrazek et al., 2013).

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In light of the scant number of studies and their methodological heterogeneity, one may be surprised by our choice to write a chapter on this topic. However, as we show in the following, despite the current limitations, important trends are emerging in this new field, and the results of the studies have important theoretical and practical implications. As we review in the first part of the chapter, studying MW in adolescents may be helpful for (i) testing theoretical views about MW from a developmental perspective and for (ii) improving our understanding of the cognitive and emotional changes and challenges associated with this life stage. Moreover, as we address in the second part of this chapter, although this field is still in its infancy, future research avenues can be already identified, and some promising directions for future development can be suggested.

The Current State of Empirical Research

Looking at the empirical evidence available on MW in adolescents, we noticed that most studies has been focused on two relevant issues, highly debated in the field of MW in adults: one line of inquiry has focused on the role played by cognitive control in MW, whereas a related but partially separate set of studies has investigated the complex association between MW and negative affect/psychopathology.

Indeed, it is not surprising that researchers have begun to examine MW from these two perspectives, because attentional control abilities as well as affect regulation and regulatory competence are still developing during adolescence and the relevance and pervasiveness of attentional problems and psychopathology are a major concern in applied, educational, and clinical contexts. The two research topics are reviewed in the following sections, moving from the theoretical questions raised in the studies on MW in adults.

Mind-Wandering and Cognitive Control

When our mind wanders, our attention drifts away from the task and the environment toward internal thoughts, mainly autobiographical ones, such as personal memories and prospective thoughts, whose content is unrelated to the ongoing task. In this specific attentional state, our attention is focused on internal stimuli, which are unrelated to the task at hand and to the current situation. Self-reports of the contents of MW episodes revealed that people are usually engaged in mental time travel, mainly wandering into their personal past and future (e.g., Mason et al., 2007). According to the current concerns hypothesis (Klinger, 2013; Klinger et al., 1973), MW experiences are more likely to occur when external information is poor/uninteresting and personal internal information has greater salience and relevance, thus capturing the focus of the individual's attention. In most cases, the thematic content of MW is driven, directly or indirectly, by the individual's goals or current

life concerns, especially when taking an appropriate action toward the goal is not possible.

One of the highly debated theoretical claims in the field of MW refers to the relation between this experience and cognitive control/executive functions: does MW reflect a failure of the executive control system over personal interfering thoughts, or does it reflect a redirection of resources from an external task toward internal thoughts? According to the control failure hypothesis (McVay & Kane, 2010), MW partly represents a momentary disruption of the executive control (i.e., proactive and reactive), whereas following the executive control hypothesis (Smallwood & Schooler, 2006), MW demands and recruits executive resources, and it reflects a redirection of control resources from external to internal processing. Both hypotheses recognize the contribution of the "presence and urgency of automatically generated, personal-goal-related thoughts (from the default-mode brain network)" (McVay & Kane, 2010, p. 195) in stimulating MW, but they provide opposite explanation of the role played by control processes. At the moment, neither the executive control nor the executive failure account can explain all the available data on MW in adults.

As suggested by some authors (Seli et al., 2016a; Stawarczyk et al., 2014), mixed findings may partly depend on the variety of the conceptual definitions of MW used in the studies and the heterogeneity of MW. As for the first aspect, operational definitions of MW cluster different experiences and attentional states together under the umbrella term of MW or "off-task" states. Unfortunately, as we show below, grouping different kinds of attentional phenomena, as, e.g., MW and external distractions, would likely lead to spurious, or even wrong, conclusions.

Up until recently, MW has been considered and measured as a unitary and homogeneous class of experiences (but see Giambra, 1995). However, a growing body of evidence has demonstrated the heterogeneity of MW, and in this regard, the distinction between spontaneous and deliberate MW seems to be quite relevant (see, for a review, Seli et al. 2016a; but see also Giambra (1989) for a seminal study on this distinction). The two types of MW differ in terms of the mental dynamics underlying the MW episodes: in spontaneous MW, task-unrelated thoughts capture attention, triggering an uncontrolled shift from the ongoing task to other trains of thoughts, whereas in deliberate MW, attention is intentionally shifted from the primary task toward internal mental contents, thereby suggesting a different balance of regulatory processes on the occurrence of the two kinds of MW.

In keeping with this, although the two kinds of MW are positively correlated (rs ranging from ~0.25 to ~0.50; Carriere et al., 2013; Chiorri & Vannucci, 2019), some studies have already shown that they are differently related with dimensions of cognitive control. For instance, in studies with samples of young adults, high levels of spontaneous MW are found to be associated with difficulty with attentional control and specifically with attentional distractibility and difficulties with shifting, whereas only small correlations with attentional control were found for deliberate MW (Carriere et al., 2013; Chiorri & Vannucci, 2019). Interestingly, spontaneous but not deliberate MW was found to be associated with attention-deficit/hyperactivity

disorder (ADHD) symptomatology in sample of adults (Seli et al., 2015; Shaw & Giambra, 1993).

Addressing the question of the role of attentional control in MW in adolescents is particularly relevant. Adolescence is a critical period for protracted maturation of the frontal lobes, and these brain maturational changes that continue into early adulthood play a crucial role in attentional mechanisms, and especially in sustained attention and cognitive control/executive functioning (e.g., Anderson et al., 2001; Boelema et al., 2014). In this regard, studies on sustained attention in adolescents confirmed the protracted maturation of these mechanisms and performance improvement from early to late adolescents (Carriere et al., 2010; Conners et al., 2003; McAvinue et al., 2012; Stawarczyk et al., 2014; Tamnes et al., 2012; Thillay et al., 2015). In addition, behavioral and neuroscientific studies have shown that cognitive control processes and control-related brain areas are still maturing and changing during adolescence (see, for reviews, Casey et al., 2005; Luna et al., 2015). The relevance and pervasiveness of attentional problems are a major concern in educational contexts (for a review, see Polderman et al., 2010).

In light of these developmental changes, investigating the association between MW and cognitive control in adolescence may help further clarify the role of cognitive control in MW and other kinds of lapses of attention, and it may also contribute to a more complete understanding of the attentional changes and challenges (i.e., inattention) among youth.

In their seminal study, Stawarczyk et al. (2014) addressed this question, measuring in a sample of 77 mid-adolescents (14–16 years) and a group of 87 young adults (19–26 years) attentional control abilities as well as the frequency of MW and other attentional states, such as external distraction, task-related interferences, and on-task states during a sustained attention task (i.e., Sustained Attention to Response Task, SART). As expected, adolescents reported lower and more variable performance on measures of attentional control, and they also showed lower performance at the sustained attention task compared to young adults. In keeping with this, adolescents reported being fully focused on the task less frequently than young adults. Interestingly, adolescents reported higher rates of external distraction than young adults, but the frequency of MW episode was equivalent for the two groups.

Moreover, despite MW frequency being negatively correlated with an attentional control composite score (combining the four measures of attentional control) in both adolescents and young adults, MW but not external distraction remained a significant predictor of the performance at the sustained attention task. This held even after controlling for attentional composite score. This finding challenges the control failure view of MW, and it suggests that MW cannot be entirely reduced to a failure in staying focused on the task. Moreover, this study shows the importance of distinguishing MW from other lapses of attention, as, for example, external distractions, which more likely reflect attentional control failure.

In this regard, over the last years, an increasing number of studies have shown that the different lapses of attention, such as MW, external distractions, task-related interferences, and mind-blanking, have different patterns during a task (e.g., Stawarczyk et al., 2011, 2014), they differ at the physiological level (Unsworth &

Robison, 2016), and they are differently affected by healthy aging (e.g., Zavagnin et al., 2014; Ziegler et al., 2018). Taken together, the findings suggest that these phenomena reflect distinct kinds of inattention.

More recently, Gyurkovics et al. (2020) further investigated the relationship between MW and attentional control in adolescents and examined the developmental change- in the frequency of MW, by comparing four age groups, namely, early adolescents (12–13 years), mid (14–15 years), late (18–20 years) and adults in their late twenties (25–27 years). Interestingly, in this study, the authors separately assessed and distinguished between aware MW (i.e., "While doing the task, I was aware that thoughts about other things popped into my head") and unaware MW ("My mind drifted to things other than the task, but I wasn't aware of it until you asked me") experienced during a sustained attention task (i.e., SART). As expected, age-related improvements in the performance at the sustained attention task were found, with the greatest differences emerging between participants under and over 18 years old. However, although the frequency of MW was found to be negatively associated with some cognitive control abilities, the developmental changes in the frequency of MW did not support the view of MW as a failure of attentional control. In fact, early adolescents reported significantly fewer aware MW episodes than late adolescents, and numerically fewer episodes than adults. As the authors suggested, different explanations for this age affect might be advanced. On the one hand, the lower frequency of MW in early adolescents may be consistent with the executive control hypothesis: MW requires and drains executive resources, and early adolescents just do not have enough resource available to generate and maintain MW during a task. However, since the age effect emerged in the frequency of MW with awareness, we cannot completely exclude age differences in the level of meta-awareness (i.e., explicit awareness of the current contents of thoughts).

On the other hand, these results might be also explained in terms of the influence of current concerns. In fact, it is possible that the group of late adolescents, mainly undergraduate students, had more university-related current concerns, which were activated by the university setting where they were tested, compared to the other groups. It is worth stressing that, to date, a systematic investigation of the respective influence of cognitive control, meta-awareness, and personal current concerns on MW frequency in adolescents and young adults is still missing, and it represents an important avenue for future research.

As we reviewed above, the results of the studies on MW in young adults suggested that the role of cognitive control in MW may also differ depending on the spontaneous/intentional nature of MW. Recently, Vannucci et al. (2020) examined whether spontaneous and deliberate trait MW differed in their pattern of association with self-reported measures of attentional control (i.e., attentional distraction and difficulty with shifting) and depressive symptomatology in a sample of 439 adolescents and specifically tested the hypothesis that difficulties in attentional control were stronger predictors of spontaneous than deliberate MW. Interestingly, the results revealed that attentional control difficulty associated with distraction was a significant predictor of only spontaneous MW, whereas difficulty in attentional shifting was a significant predictor of both types of MW, although a stronger

predictor for spontaneous than for deliberate MW. These findings confirm that MW is a heterogeneous phenomenon also in adolescents and that conflating the spontaneous and deliberate types could lead to incorrect conclusions, although they are moderately correlated ($r = 0.60$). As for attentional control, the authors could replicate the results obtained with young adults showing that spontaneous MW is more closely tied to attentional control problems (external distractibility and difficulty in task-shifting) than deliberate MW (Carriere et al., 2013; Chiorri & Vannucci, 2019). Specifically, the results shown for deliberate MW confirm the view that MW cannot be entirely reduced to attentional control failures, and the influence of other variables (e.g., motivation, arousal, personal current concerns) needs to be considered to explain the frequency of this phenomenon.

Mind-Wandering, Negative Affect, and Psychopathology

A second, highly debated, issue in the field of MW in adults consists in the association between MW and negative affect and depression. In several studies in adults, MW has found to be closely linked with negative mood: a positive association between the frequency of MW and measures of negative mood and negative thinking has been reported (e.g., Marchetti et al., 2012; Murphy et al., 2013; Smallwood et al., 2005, 2007, Experiment 1; Smallwood et al., 2004, Experiment 3). In keeping with this, several studies show that clinically and subclinically depressed patients report high levels of MW (e.g., Marchetti et al., 2013, 2014; Smallwood et al., 2007; Watts et al., 1988) and individual differences in depressive symptoms are associated with a higher frequency of MW (e.g., Smallwood et al., 2005). As for the direction of this association, evidence suggests for a reciprocal influence between MW and mood: MW may contribute to lower mood (Killingsworth & Gilbert, 2010), and in turn, lower mood may lead to, or increase, MW (Smallwood et al., 2009).

At the theoretical level, Marchetti et al. (2016) proposed a model where MW functions as a precursor of cognitive vulnerability in individuals who are at risk of developing depressive symptoms. This depressogenic effect is expected to occur in individuals who show high levels of negative affectivity or experience intense stress, where the focus of MW becomes increasingly narrower and turns into a repetitive, self-detrimental process. Under these circumstances, MW is no longer an adaptive phenomenon, but it fosters the emergence and maintenance of vulnerability factors (e.g., rumination, hopelessness, cognitive reactivity, and low self-esteem), which likely lead to the onset of depressive symptoms.

Other researchers have proposed a partially different relationship between MW and mood, suggesting that it may indeed depend on the contents of thoughts generated during MW. Thoughts and emotions generated during MW episodes may vary widely across individuals and situations, and this variability may occur along some properties of MW, such as temporal orientation (e.g., thinking about the future vs. the past), affective valence (e.g., negative, positive, or neutral content), as well as self-referential quality (e.g., thoughts related to the self vs. others) (Smallwood &

Schooler, 2015). As stated by Smallwood and Andrews-Hanna (2013), "While some forms of thought content are linked to maladaptive outcomes including psychological distress and unhappiness, other forms highlight the adaptive nature of the experience" (p. 3) (content regulation hypothesis).

In this regard, some evidence has been reported for an association between negative mood and past-oriented MW: negative/low mood tends to skew MW toward the past (e.g., Poerio et al., 2013; Ruby et al., 2013; Smallwood & O'Connor, 2011), and, in turn, the occurrence of past thoughts during MW is associated with subsequent negative mood (i.e., Ruby et al., 2013).

Similarly, other studies found that the affective content of MW was both predicted by previous mood and associated with later mood, so that greater levels of sadness prior to MW predicted MW with sad contents and these negative thoughts exacerbated subsequent negative mood (Poerio et al., 2013). In line with this, Franklin et al. (2013: see also Schooler et al., 2014) found that the effect of a MW episode on mood was a function of how interesting the content of MW was: highly interesting MW contents were associated with an increase in positive mood compared to on-task episodes.

The multiple emotional, social, and cognitive changes characteristics of the life phase of adolescence make young people vulnerable to psychological distress and mental health problems. According to some studies, approximately one third of adolescents develop depressive symptoms, even if they do not meet the criteria for clinical depression (e.g., Compas et al., 1993). In light of this, enhancing our understanding of the association between MW and both negative affect and psychological distress in adolescents may have important implications, not only at a theoretical level but also for designing intervention to promote psychological well-being (see Smallwood & Andrews-Hanna, 2013).

In one of the first studies that addressed this issue in adolescents, Mrazek et al. (2013) found that high levels of trait MW (as assessed by the Mind-Wandering Questionnaire, MWQ) were associated with worse mood, less life satisfaction, greater stress, and lower self-esteem among high school students and middle school students (11–13 years of age). In the validation study of the Chinese version of the Mind-Wandering Questionnaire, carried out on a sample of 1331 adolescents, Luo et al. (2016) found that adolescents with a higher tendency of MW reported lower levels of self-esteem which were in turn associated with decreased life satisfaction. As the authors explained, increased MW may lead to excessive self-attention (Mor & Winquist, 2002), which may increase the risk of self-evaluation and judgment, thereby leading to negative emotions and low level of satisfaction.

In a very recent study, Webb et al. (2021) used an experience sampling method (ESM, or ecological momentary assessment, EMA) to examine the frequency, content, and affective correlates of MW in a group of adolescents with anhedonia and depressive symptoms and a group of typically developing controls, along with other goals not reported here. In the study, participants completed a resting state fMRI scan, and they received an EMA survey two to three times per day for 5 days, answering questions about their positive and negative affect, mind-wandering

(frequency, time orientation, and affective valence), current activity, social context, and rumination.

The results show that adolescents with anhedonia and depressive symptoms reported a higher frequency of MW relative to controls, and they were more likely to mind-wander to unpleasant content relative to pleasant and neutral contents. Across both groups, overall MW was associated with higher concurrent negative affective even when controlling for other confounding variables (e.g., current activity, social companion, rumination). However, it is important to note that for both groups, positive affect was highest when the mind wandered to pleasant content and lowest when the mind wandered to unpleasant content. Overall, it appears that MW in adolescents is associated with negative affect; nonetheless, the content of MW and specifically the emotional valence of thoughts is a moderator of this relation, thereby suggesting that it is not MW per se that have negative implications on mood. As the authors discussed, the result that participants with anhedonia and depressive symptoms reported higher levels of MW and worse mood does not imply that mind-wandering per se may cause worse affect, in that other factors (i.e., attentional control difficulties) may have contributed to the increased levels of MW in adolescents with depressive symptoms.

In the aforementioned study, Vannucci et al. (2020) directly examined the association between trait levels of MW in daily life and depressive symptomatology, distinguishing between spontaneous and deliberate MW. The authors found that both kinds of MW were associated with depressive symptomatology, although the effect was stronger for spontaneous MW. Interestingly, this association was present even after partialling out the effect attentional control.

Due to the pioneering nature of this study, being the first one carried out on these correlates of spontaneous and deliberate MW in adolescents, we can only speculate on the mechanisms underlying these patterns of results. To date, the few results obtained on these associations with sample of adults are mixed: in a study on young adults, Seli et al. (2019) found that only trait spontaneous MW was positively associated with depression, whereas in a sample of elderly people, El Haj et al. (2019) found that both kinds of MW were positively associated with depression. On the one hand, one might argue that the association between the two types of MW and depressive symptomatology might change in relation to age, and, consequently, a person-oriented approach (such as EMA, used by Webb et al., 2021) and longitudinal study design would help delineate the direction of this association in relation to different groups. On the other hand, it might be that other phenomenological properties of MW, such as temporal orientation and affective valence, may be more relevant than the intentionality of MW in explaining the association with depressive symptomatology.

Another methodological aspect that needs to be taken into consideration is that the self-report measure of intentional MW includes items that refer to the enjoyment of the MW experience and/or generation of pleasant fantasies. Some studies have found that wishful thinking and positive fantasies about the future were associated with lower effort, performance, and well-being compared with planning and positive expectations (see, for a discussion, Oettingen et al., 2016).

Future studies are needed to further investigate these aspects and clearly distinguish MW from other related phenomena, as wishful thinking and maladaptive daydreaming (i.e., need and excessive engagement in vivid, fanciful, and immersive fantasies), which have been found to be associated with elevated psychopathological symptoms (see, for a discussion, Soffer-Dudek & Somer, 2018).

Challenges and Future Directions

As we described above, studies on MW in adolescents have confirmed the complexity of this experience, which is far more than a failure of attention, and they suggest the necessity of distinguishing MW from other kinds of inattention (e.g., external distraction, task-related interferences). Moreover, research clearly shows that the rich variety of MW, in terms of contents (e.g., time orientation, affective valence) and mechanisms (e.g., spontaneous MS vs. deliberate MW), needs to be considered when we examine the cognitive and emotional costs of MW.

We believe that the adoption of a multidimensional perspective on MW, which has already proved to be useful (e.g., Seli et al., 2016a; Smallwood & Andrews-Hanna, 2013), would provide a greater understanding of other relevant costs and benefits associated with this experience in adolescents.

Mind-Wandering in Educational Settings

An important avenue for future research would be the identification of the impact of MW in educational and learning contexts. Studies on MW during classroom and online lessons have shown that students spend a relevant portion of time experiencing MW and the amount of MW during a lecture is negatively correlated with educational outcomes, such as poor comprehension and retrieval for the lecture material and poor note-taking (e.g., Lindquist & McLean, 2011; Risko et al., 2012, 2013; Szpunar et al., 2013). Moreover, some studies suggested that state MW mediated the relation between motivation and performance (e.g., reading comprehension; retention of lectures material) in adults. In detail, participants with low levels of motivation were more likely to engage in state MW during reading tasks and this negatively predicted their performance (Unsworth & McMillan, 2013), while another study showed that participants with higher level of motivation to learn experienced less state MW (both spontaneous and deliberate) during the lecture, and this was in turn associated with improved retention of lecture material (Seli et al., 2016b).

In the light of these costs of MW and given the role played by reading comprehension and literacy-related skills in effective learning in adolescents, this line of investigation is particularly relevant. To date, only two studies have attempted to address this research problem in adolescents (Desideri et al., 2019; Mrazek et al., 2013): state MW during a reading comprehension test was found to be associated

with worse reading comprehension, whereas no significant associations between trait MW and reading comprehension and other literacy-related skills were found. In the study by Desideri et al. (2019) in late adolescents, trait MW was a significant predictor, along with test anxiety and self-efficacy, of academic self-concept (defined as "an individual's perception of his or her learning capabilities and difficulties in different learning domains" (p. 3)). In other words, higher levels of trait MW were associated with a poorer academic self-concept. As the authors pointed out, we should also consider the "social" evaluation of MW in educational contexts. Many teachers have a negative representation of MW, in that it is considered as a factor contributing to scholastic failure, and it is likely that students whose mind often wanders received negative feedback about this experience, which in turn may lead to develop a negative representation of MW.

Mind-Wandering, Identity Construction, and Adaptive Outcomes

So far, the investigation of potential functional roles and benefits of MW in adolescents has been completely neglected. In studies with young adults, MW has been found to be associated with a wide variety of benefits, including future planning and simulation, management of personal goals, problem-solving, and decision-making (see, for a review, Mooneyham & Schooler, 2013; Smallwood & Schooler, 2015). More generally, MW has been found to contribute to the construction of a sense of self-identity and continuity across time (see for a discussion Klinger et al., 2018), and this seems to be true across culture (e.g., Song & Wang, 2012).

Given that identity development is a core task of adolescence (Erikson, 1968; Pfeifer & Berkman, 2018; Becht et al., 2018), the contribution of MW to the exploration of the emerging identity and to self-related processes as self-verification and autobiographical planning is worth prioritizing in investigations in adolescents. In this regard, a multidimensional evaluation of MW, which considers the spontaneity/intentionality of MW as well as other qualitative aspects of the contents of MW episodes, could be quite promising, in order to identify effective ways in which MW may support the development of a strong identity.

Moreover, studies on spontaneous and deliberate MW in adults have provided evidence for a constructive and functional value of deliberate MW. For example, high levels of deliberate MW are found to be positively associated with originality at a divergent thinking task and with positive-constructive daydreaming style, openness, and self-reflection (i.e., adaptive kind of inspection of one's own thoughts and feelings), whereas levels of spontaneous MW are found to be associated with low originality and with high levels of self-rumination (i.e., maladaptive, persistent, inflexible, and inappropriate self-consciousness) (Agnoli et al., 2018; Marcusson-Clavertz & Kjell, 2019; Vannucci & Chiorri, 2018). In a similar vein, studies investigating the contents of MW have shown that engaging in thoughts that are personally interesting is associated with more positive mood and, under some situations, it may be an effective escape from boredom (Mooneyham & Schooler, 2013).

Capturing the Complexity of Mind-Wandering

More generally, a comprehensive (i.e., both state and trait MW) and balanced (i.e., costs and benefits) investigation of complexity of MW in adolescents is desirable, not only for theoretical reasons but also for designing adequate educational strategies/psychological interventions. By doing so, we could aim at reducing the learning and emotional costs of MW, without reducing its potential benefits. The ultimate goal is not to find an antidote for MW, but to minimize the negative outcomes and possibly "to allow and foster MW potential" (Desideri et al., 2019, p. 12).

This ambitious goal could be met only if methodological innovations follow closely. Research on MW in adults has greatly benefited from the use of the "strategy of triangulation" (Smallwood & Schooler, 2015), whereby self-reports, behavioral measures, and physiological measures are combined together in the same study to make inference about the attentional states experienced during a task. Neuroscientific techniques (e.g., fMRI, event-related potentials, eye movements, and pupillometry) have provided a great contribution to our understanding of the remarkable mental activity involved in MW, which entails complex higher-order neural mechanisms, and to distinguish MW from other kinds of attentional processes. Using a joint behavioral-pupillometry paradigm, Pelagatti et al. (2018, 2020) recently started addressing the question of the duration of MW episodes, providing objective measures about the temporal unfolding of MW. To date, with a few exceptions, research on state and trait MW in adolescence has relied on self-report and, in some cases, behavioral measures of MW. Identifying reliable behavioral and physiological measures of MW and other attentional states in adolescents and comparing these measures with the ones reported in young adults may help conceptualize MW and its costs and benefits in a developmental perspective.

Conclusions

Although the investigation of MW in adolescents is still in its infancy, the few studies on this topic have already started addressing some relevant and controversial issues, related to the association between MW and cognitive control and MW and negative mood. Overall, the results of the studies show that MW in adolescents is far more than a failure of attentional control and that it is not detrimental per se. Moreover, in line with the evidence coming from studies on MW in young adults, the results of the studies with adolescents demonstrate (i) the necessity of a clear operational definition of MW, which distinguishes MW from other kinds of lapse of attention, and (ii) the usefulness of a multidimensional approach to MW, based on the recognition of the heterogeneity of MW, in terms of both mechanisms and contents. In this regard, although this field of research is a relatively new one, we could identify some lines of research and future developments. Our suggestions for future research are not the only ones that might improve our understanding of MW from a

developmental perspective, but they may significantly contribute to build a more balanced view of MW and its complexities (i.e., costs and benefits), with clear implications for both educational and psychological interventions.

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Chapter 4
Mind and Body: The Manifestation of Mind Wandering in Bodily Behaviors

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Introduction

Cogito, ergo sum. According to the standard philosophical interpretation of this well-known statement, Descartes expressed that we know that we exist because we are aware of our thoughts. In other words, our existence depends on our ability to be aware of ourselves as agents in the world. Alternatively, though, one could argue that sum, ergo cogito, for it is the very fact that we exist – that our brains reside in a physical body– that enables us to be conscious. That is, the experience of our thoughts depends on our physical manifestation and interaction with the world. In that way, cognition and perception are intertwined with action, and together, our minds and bodies interact in order to navigate the world around us.

The way we act upon the world around us is both constrained and driven by the affordances of our environment, which we learn through experience and knowledge acquisition throughout life. For instance, we know that a glass can hold liquid, that we can drink from it by picking it up and bringing it to the mouth, and that it shatters when it falls. This means that we can also make predictions: if a glass drops from one's hands, there will be a noise followed by sharp shards lying on the floor. Hearing the noise and potentially freezing (because the new situation might be

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dangerous) are typical ways in which the body interacts with the environment: perception (a noise) leads to a prediction (danger), which leads to an action (freezing). This, in turn, leads to a new situation in which one checks the environment for sharp shards, followed again by predictions and actions. This process is known as the perception-action cycle (Fuster, 2002, 2004). The fact that we constantly make predictions about the environment that guide our actions means that we need to be aware of the affordances of the environment. This means that there is a tight coupling between our behavior and the environment such that strong predictions make movements almost automatic, while small deviations inevitably lead to accidents.

These deviations become more likely when our attention needs to be divided between the world around us and the world within us. During a substantial part of our daily lives, our thoughts are not focused outward toward external events and stimuli, but rather inward, processing internal states that are decoupled from the reality around us at that particular moment. For centuries, philosophers, writers, and scientists have tried to understand the purpose and dynamics of such thoughts, yet only more recently, we have begun to examine experimentally how and why humans entertain cognitions with little relation to external events, and how this process manifests in observable behavior. More interest in internally directed cognition has been ignited by the discovery of the default mode network by Raichle et al. (2001), who found that during resting episodes recorded using functional magnetic resonance imaging (fMRI), the brain is, in fact, far from idle. A stream of thoughts flows through our minds related to exteroceptive signals (e.g., lights, sounds, smells), interoceptive signals (e.g., hunger, tiredness), as well as internally generated, stimulus-independent thoughts akin to mental simulations and related to our memories, goals, and plans for the future. This process is often referred to as mind wandering, and can be characterized by a decoupling of attention and information processing from the external environment in favor of internally generated thoughts and feelings (Smallwood, 2013; Smallwood & Andrews-Hanna, 2013; Smallwood & Schooler, 2006). Numerous studies have shown that mind wandering sometimes arises spontaneously and without conscious awareness, while at other times, it appears to be a deliberative act where attention is consciously directed to a particular train of thought (Seli et al., 2016). A typical example of mind wandering without awareness, or "zoning out," occurs during reading when we may find ourselves reaching the end of a page, but having no idea what we just read or where our thoughts went in the meantime (Schooler et al., 2011).

The main argument of this chapter is that mind wandering can influence bodily behavior by causing a partial breakdown of the perception-action cycle. Perception of external stimuli is attenuated during mind wandering, and, therefore, predictions and actions become more inaccurate or less efficient. In addition, mind wandering affects the body in other ways: one's posture might change, and the change in mental state might be reflected in facial features. Interestingly, there are also specific non-instrumental behaviors, such as fidgeting, that are associated with mind wandering, suggesting that mind wandering not only changes how the body interacts with the environment, but also that mind wandering is (at least to some extent) embodied.

On the Costs and Benefits of Mind Wandering

Mind wandering seems to be an essential human characteristic which enables us to remember the past, to plan for the future (Baird et al., 2011; Mooneyham & Schooler, 2013; Smallwood & Schooler, 2015), and to be creative (Baird et al., 2012). It also provides us with freedom from immediacy (Smallwood & Andrews-Hanna, 2013) and makes it possible for us to travel through time as we daydream (Baird et al., 2011). In fact, mind wandering seems to allow us to integrate our past and present selves with our future and imaginative experiences, serving to consolidate our memories (Wamsley, 2018) and to create and maintain a coherent sense of self (Mooneyham & Schooler, 2013; Ottaviani et al., 2013; Smallwood & Andrews-Hanna, 2013; Tulving, 1987). Some researchers assume that mind wandering can be linked to the default state of the human brain (Mills et al., 2018). In this default state, thoughts ceaselessly move from one topic to the next, with heightened variability over time. This flow and variability might serve to improve episodic memory efficiency (Faber, 2020). This seems to be supported by studies both in laboratory settings (Wamsley & Summer, 2020) and in daily life (Smith et al., 2018).

Despite its various benefits, mind wandering has been found to be detrimental in a wide variety of contexts, including both nondemanding and challenging tasks. It has been associated with decreased text comprehension (Krawietz et al., 2012; Smallwood et al., 2008b) as well as increased number of errors in memory (Riby et al., 2008), including working memory (Banks & Boals, 2017; Mrazek et al., 2012) and vigilance tasks (McVay & Kane, 2012; Stawarczyk et al., 2011). In daily life, mind wandering has been related to lower performance in general aptitude tests (Mrazek et al., 2012), and learning and performance in academic contexts (Wammes et al., 2018). It has even been used to explain differences in the Socioeconomic Status Academic Achievement Gap (Gearin et al., 2018).

The ebb and flow of mind-wandering thoughts is dependent on a variety of factors. As such, the extent to which mind wandering is detrimental (or conversely, beneficial) varies largely according to the context in which it takes place. Across a variety of experience sampling studies, students[1] report mind wandering during around 30% of their daily lives (Kane et al., 2007; McVay et al., 2009). Unsworth and Mcmillan (2012) found that three quarters of these mind-wandering reports take place in the classroom. Mind wandering is therefore more likely to take place during classroom-related activities than in everyday life. However, mind-wandering rates vary according to the type of activity being performed in the classroom. For example, Schoen (1970) notes that students report being focused approximately 67% of the time during lectures, 75% of the time during discussions, and 83% of the time when problem-solving. Not surprisingly, less mind wandering takes place in more interactive and engaging activities in the classroom. More recently, Wammes

[1] Apparently, this seems to be true not only for students but also for the general population (Smallwood & Schooler, 2015).

et al. (2016) found mind wandering in the classroom to be related to both short-term (quizzes) and long-term (exams) performance decrements.[2]

As educational activities require considerably more sustained attentional focus than everyday activities, it is not surprising that more mind wandering takes place in classroom settings. In line with this, the negative consequences of mind wandering in tasks requiring sustained attention – such as attending a lecture, reading an article, or studying for an exam – are also greater than in largely automatized day-to-day tasks, such as having breakfast, checking e-mail, or scrolling through social media feed (Szpunar et al., 2013). Relatedly, mind-wandering frequency generally decreases with task difficulty. However, once a task becomes too difficult (Smallwood, 2013; Smallwood & Andrews-Hanna, 2013), mind-wandering rates increase again. Whenever a task is easy, there are sufficient attentional resources both for task performance and for mind wandering. Once a task becomes exceedingly difficult, because of either lack of knowledge or resource depletion, attention is decoupled from the task at hand and mind wandering ensues (Randall et al., 2014; Smallwood, 2013; Smallwood & Andrews-Hanna, 2013).

Given the prevalence and the detrimental effects of mind wandering in classroom settings, it would be helpful if educators could be provided with tools to detect when these episodes take place. Such information might also be particularly useful for intelligent tutoring systems. In what follows, we discuss the relationship between cognition and bodily behaviors in the context of performance and learning. We then address the value of integrating bodily behaviors into cognitive architectures in order to further our understanding of mind wandering in the context of perception and action.

Mind Wandering and Bodily Behaviors

During most of our waking moments, we are engaged in some sort of movement, often well practiced and automatized, such as reaching for objects, walking, and speaking. We do not need to actively think about these well-practiced actions – we simply perform them as we engage in goal-oriented behavior, with little to no demands on our attention (or conscious input). There are, however, bodily movements that do not serve a clear purpose in the outside world – such as fidgeting, tapping one's fingers or feet, rubbing the chin, or twirling the hair while paying attention to an unrelated external stimulus. Arguably, these types of behaviors are indicative of mind wandering and thus represent physical expressions of our mental state, i.e., its embodiment. In the following sections, we first address the manifestation of mind wandering in disrupted executions of bodily behaviors associated with

[2] In the study, intentional mind wandering was associated with poorer quiz results and unintentional mind wandering was associated with poorer exam results.

goal-oriented, attentive actions and then discuss the links between mind wandering and non-instrumental bodily behaviors.

Sensory-Motor Decoupling

There is a bidirectional relationship between attention and correlated body movements such that regions in the brain associated with motor-planning influence attention (Armstrong & Moore, 2007; Knudsen, 2007; Moore et al., 2003), and in turn attention influences sensorimotor brain areas (Rosenkranz & Rothwell, 2004) as well as sensorimotor integration (Velasques et al., 2013). When the mind wanders, there is an attenuation of processing in neural systems that are often engaged with the external sensory-motor environment in order to guide behavior (Kam & Handy, 2013; Smallwood & Andrews-Hanna, 2013). Various studies indicate that there is a decrease in alertness and sensory processing during mind wandering. In support of this claim, experimental studies consistently report higher variability in reaction times (e.g., McVay & Kane, 2009; van Vugt & Broers, 2016) and reduced accuracy in a variety of tasks (e.g., Smallwood & Schooler, 2015) during mind-wandering states. Although it is not yet clear at what point behavior starts to waver, previous work has shown that in a metronome task, behavioral variability is significantly higher across the five trials prior to a mind-wandering report than before an on-task response (Seli et al., 2013). Indeed, there is evidence to suggest that the response time variability in the four to eight trials preceding a positive mind-wandering probe is a robust predictor of mind wandering (e.g., Bastian & Sackur, 2013).

Although the increase in behavioral variability has been firmly established in the literature, there are conflicting findings with regard to whether responses speed up or slow down during mind wandering across a variety of tasks. While some studies have shown that faster responses are associated with mind wandering (e.g., SART; McVay & Kane, 2012; McVay et al., 2009, collapsed across four trials preceding a report), others have demonstrated that response times linearly decrease during mind-wandering episodes (Bastian & Sackur, 2013; Smallwood et al., 2008a). When further investigating the time course of responses prior to a mind-wandering report, there is evidence to suggest that response times are in fact faster in the five to two trials before a mind-wandering report, followed by a sharp decrease in the trial just before the report (Henríquez et al., 2016). Despite methodological differences across the cited studies, these findings appear to suggest that the variability associated with mind wandering is not simply a result of linearly slowing down, but potentially speeding up and then slowing down. Further research that scrutinizes the time course of on- and off-task behavior across larger time scales might shed light on these time-dependent relationships. Taken together, and irrespective of the direction of the relationship, these findings point towards the idea that bodily behavior (in this case, response time) deviates from on-task behavior during mind wandering, suggesting that there is a degree of decoupling between the perception of the external environment and the bodily action.

Hand Movements

Behavioral measures such as reaction times provide valuable insight with regard to the relation between mind wandering and task performance. However, these measures are unable to capture the fine-grained dynamics of movement leading up to the crucial moment during which performance is measured (usually a click or a button press). As embodied cognizers, we adaptively monitor and minutely adjust our movements in response to external demands on a moment-to-moment basis in our daily lives. Therefore, it is likely that the effects of mind wandering on behavioral control involve more than just speed and accuracy of responses (Kam et al., 2012). Dynamic measures across time obtained from process tracing methods are a promising method that allows for collecting more detailed information about this process.

Mind Wandering During a Forced-Choice Reaching Task In the study reported by Dias da Silva and Postma (2020), we tracked participants' hand (motor) movements and measured mind wandering under an engaging and cognitively demanding task.[3] During this task, participants were instructed to memorize a series of letters while at the same time performing mathematical operations for approximately 20 minutes. After each set of letter recall and math operations, participants could have selected one out of three probe responses: (1) I was focused on the task, (2) I was concerned about my performance on the task, or (3) I was thinking about something unrelated to the task, where the third alternative indicated mind wandering (operationalized as task-unrelated thought). We extracted various mouse tracking measures from x- and y-coordinates recorded across time. Using these measures as features in several machine learning models, we were able to predict mind wandering above chance level. We found that computer mouse movements become more complex (operationalized by more direction changes along the x- and y-axes), less direct, and slower during mind wandering than during moments of focused attention. Upon closer observation of the speed of the movements, we found that not only were movements slower in general, but also the first phase of the reaching movement toward a response was slower. More specifically, this means that individuals took longer to commit to a response whenever they were mind wandering.

Mind Wandering During a Visuomotor Tracking Task In a second study reported by Dias da Silva and Postma (2021), we investigated the relationship between fine motor movements during a monotonous tracking task, lasting approximately 1 hour. Participants were instructed to trace the path of a moving ball on a screen while intermittently reporting whether or not they were focused on the task. Whenever they were mind wandering, participants indicated to what extent their attention was decoupled from the environment, to what extent they imagined being somewhere else, and to what extent the content of their thoughts varied. We found that whenever participants were mind wandering, their hand movements deviated

[3] Operation Span task (Unsworth et al., 2005).

more from the path of the ball and were less variable. Moreover, the deeper the reported episodes of mind wandering, the more erratic and less variable their hand movements.

In line with previous work (Kam et al., 2012), we found that fine motor movements change in relation to one's attentional state. During both a reaching task and during a tracking task, the action-perception loop appears to be disrupted by the mind-wandering process resulting in less efficient hand movements.

Eye Movements

Changes in eye movements have also been extensively investigated in relation to mind wandering in a variety of tasks, ranging from reading (Bixler & D'Mello, 2016) and online lectures (Khorrami et al., 2014) to interactions with automatic tutoring systems (Hutt et al., 2016), and have been found to be good predictors of mind wandering and attention. Taken together, deviations in gaze patterns from on-task, instrumental behavior in various tasks suggest a decoupling between gaze and the external environment. Studies related to eye tracking are reported extensively in Dias da Silva et al. (2022), this book.

Vocal Movements

The production of speech constitutes a highly automated type of movement involving precise actions of the muscles in the vocal apparatus. Among these, the opening and closing of vocal folds results in minor changes in pitch, the perceptual correlate of fundamental frequency. In terms of the auditory characteristics of speech, pitch is an important indicator of the identity, emotions, and attitudes of a speaker (Postma-Nilsenová et al., 2013). Moreover, the ability to correctly perceive pitch in another's speech and to adapt one's pitch accordingly is indicative of rapport, cooperation, and social proximity (Dias da Silva et al., 2018; Giles, 2008; Pardo, 2006; Postma-Nilsenová et al., 2013; Postma-Nilsenová & Postma, 2013). In fact, during vocal interactions, speakers unknowingly accommodate to one another's pitch patterns. In a study with a virtual agent (Dias da Silva et al., 2018), we observed that participants who were induced into a repetitive, self-focused style of thinking, characteristic of ruminative mind wandering, exhibited a reduction in pitch accommodation. As such, we thus provide initial evidence for the manifestation of mind wandering in less adjusted vocal movements.

Non-instrumental Movement

As discussed earlier, many of our goal-related actions are expressed through bodily movements. For instance, the eyes might move across the screen to sample visual information, the head might move to get a better viewing angle, one might lean in to take a closer look, or one might operate a computer mouse or touch screen using their hand to navigate the screen (Witchel et al., 2014). However, not all movements are associated with goal-oriented actions. For example, fidgeting is a common, but non-instrumental, behavior we exhibit. Other examples include changes in posture that are not instrumental to the task, such as leaning back as a sign of disengagement; hand movements that are non-instrumental, such as touching the face, rubbing the eyes, or scratching; and facial expressions (Witchel et al., 2014). Relatedly, recent evidence also suggests that what was previously thought to be "nonessential" behavior plays an invaluable role in shaping the neural activity in expert mice performing tasks (Mathis, 2019). There are, however, mixed findings with regard to the relationship between mind wandering and non-instrumental movement. Sometimes non-instrumental movement (e.g., tapping fingers along with the rhythm of a song) is associated with attention or engagement toward a task, while others are associated with disengagement or mind wandering (e.g., restless foot or leg movement). Witchel et al. (2014) reconcile such discrepancies by suggesting that the attentional state can be distinguished by whether or not movements are entrained – that is, whether movements are timed to the rhythm of an external stimulus. We propose here that mind wandering may be reflected in such types of non-instrumental movements, which are not entrained to stimuli, suggesting that non-instrumental movement could be seen as an "embodied" manifestation of mind wandering.

In support of this notion, studies have shown fidgeting to significantly increase during unintentional mind wandering (Carriere et al., 2013; Seli et al., 2014). In a first questionnaire study, Carriere et al. (2013) found that participants who report mind wandering more (both deliberately and spontaneously) also report more fidgeting. In a study assessing fidgeting behavior (as coded by external observers) while students watched an online lecture, Farley et al. (2013) found both macro fidgeting behavior (operationalized as a complete spatial displacement of a body part relative to a starting position, such as moving the arm to a completely new location) and mind wandering to be related to one another and to increase with time on task. Moreover, Seli et al. (2014) found particularly deep levels of mind wandering to be associated with fidgeting (operationalized as the total amount of movement detected by a Wii Balance Board) during a Metronome Response Task. Finally, Witchel et al. (2019) found that while reading an interesting novel, students fidgeted less than when reading a boring novel. Similarly, doodling or humming a tune (a vocal movement) during performance of a monotonous task could also be an indicator of mind wandering (Farley et al., 2013; Smallwood & O'Connor, 2011). These findings may suggest that non-instrumental movements, reflective of mind wandering, may be a way to cope with boredom during a task (Elpidorou, 2018).

Facial Features

Facial expressions are another non-instrumental behavior commonly found to accompany attentional states during task performance. Various studies have found that facial features can be used to detect engagement and attentional focus (or a lack thereof) during computerized tasks (Monkaresi et al., 2017; Whitehill et al., 2014). In a recent study by Benedek et al. (2018), participants were asked to determine the locus of attention of people in various videos. The videos showed the faces of people either who were focusing their attention externally on a task or who were focused internally while performing the task in their mind's eye. People in the video were asked to perform the following four tasks: solve an anagram in the computer screen (demanding external condition), solve an anagram in their mind's eye (demanding internal condition), count the number of journeys made by the tractor in a video on the screen (easy external condition), and imagine themselves on a beach and exploring this environment (easy internal condition). Participants who evaluated the videos found that the eye region was the most important determining factor for their judgments. They found a different pattern (e.g., directed eye movements in external attention vs. empty gaze during internal attention) and speed of eye movements to be discriminative of internal and external focused attention. Overall, participants were able to determine people's locus of attention at above chance levels from the videos, but had difficulty distinguishing between internal and external attention during more demanding tasks. This is not surprising, considering the fact that solving an anagram in the mind's eye is equally difficult, if not more difficult, than on a screen. Working memory and executive resources are engaged in both of these tasks, resulting in more tense[4] facial expressions for both conditions. Moreover, mental imagery under this demanding task likely resulted in similar eye movements to those from actual perception of stimuli on the screen (Johnson & Whisman, 2013). Taken together, these findings indicate that there are overt indicators of attention which enable us to detect others' attentional states from facial expressions. Other studies have instead used machine learning techniques in combination with self-reported measures of mind wandering, demonstrating initial evidence for automatic mind-wandering detectors outperforming human observers in determining other's attentional states (Bosch, 2016). For example, both Stewart et al. (2017) and Bosch (2016) used facial and upper body features extracted from video recordings both in the lab and in the classroom settings to detect student's self-reported attentional states above chance levels. Stewart et al. (2017) found that lip tightening and jaw dropping facial action units seemed to be able to generalize across task contexts (reading a scientific text and watching a narrative film). Bosch (2016) found that texture features, which indicate changes in facial expressions, were the strongest predictors of mind wandering during reading and interacting with an intelligent tutoring system.

[4] More tense facial expressions, e.g., furrowing of the eyes and brows, are generally associated with high levels of visual engagement (Benedek et al., 2018; Whitehill et al., 2014).

Non-instrumental Behavior as an Exploratory State

An interesting line of research indicates that non-instrumental behavior in the form of doodling while performing a boring task actually enhances performance on the primary task (Andrade, 2010). Such "nonessential" behavior (fidgeting, doodling, humming) potentially enhances arousal to levels associated with optimal task performance (Farley et al., 2013; Risko et al., 2013). A similar account of mind wandering has been proposed in the context of Attentional Blink studies, where inducing participants to mind wander actually improved participant performance. If non-instrumental behavior could be indicative of mind wandering, it seems counterintuitive then that performance would be enhanced, especially considering the substantial amount of literature that demonstrates that mind wandering is actually detrimental to performance (Smallwood & Schooler, 2015). In the context of the Attentional Blink, it has been proposed that mind wandering actually helps distribute attention more broadly in the environment (Forster & Lavie, 2014), reflecting an adaptive cognitive style intended to maximize the efficient processing of events (MacLean et al., 2012). Relatedly, it could be that non-instrumental behavior associated with mind wandering is indicative of exploratory off-task states described by Mittner et al. (2016). During such off-task states, attention is dispersed as we broadly scan both our external and internal environments in order to determine if on-task goal directed thinking or mind wandering should be the next state to be exploited. Consequently, we are able to maintain reasonable levels of performance while at the same time mind wandering. Farley et al. (2013) propose that non-instrumental behavior could potentially reflect an attempt to combat waning attention. It could be that fidgeting, doodling, or humming, for example, stabilizes arousal (to optimal levels) in order to facilitate performance on a primary task (Andrade, 2010; Farley et al., 2013; Risko et al., 2013). Alternatively, such behaviors could reflect the transition into a state of inattention and in turn, mind wandering. In both of these explanations, non-instrumental behavior is linked to the presence of inattention, either in order to redirect attention to the task at hand or as the marker of internally directed attention (Farley et al., 2013).

Computationally Modeling Mind-Wandering and Related Body Movements

Clearly, there is a rich body of literature relating mind wandering to bodily behaviors. It seems that mind wandering, when defined as a decoupling of attention from the external environment, is associated with an attenuation in bodily behaviors that are instrumental. Additionally, it could be that more exploratory forms of mind wandering manifest as non-instrumental behaviors which are not entrained to external stimuli, such as fidgeting, doodling, or humming.

Formalizing the dynamics of thought in computational models allows us to directly test hypotheses and theories concerning how mind wandering takes place and manifests in bodily behaviors. Computational models enable a moment-to-moment simulation of the ebb and flow of our thoughts and can help us to understand how a variety of task and cognitive factors affect behavior. They serve as theories to explain how different psychological phenomena work, accounting for complete tasks, starting with perception through to response execution (Borst & Anderson, 2015). The better a simulation fits the actual data, the better the cognitive model. To date, most of the quantitative computational cognitive models of mind wandering have been based on data collected in the SART (with a few exceptions). The Adaptive Control of Thought-Rational (ACT-R) is the most widely used cognitive architecture that computationally models processes from perception to action for a wide range of cognitive tasks (Anderson, 2007). Several computational models have been implemented in the ACT-R to describe fluctuations in states of focused attention and mind wandering during SART (Hiatt & Trafton, 2015; Van Vugt et al., 2015; van Vugt & van der Velde, 2018). Recent studies have successfully combined cognitive modeling with neurophysiological data. For example, Klaproth et al. (2020) used EEG data to inform and constrain their cognitive architecture. In addition, Borst and Anderson (2015) used ACT-R for modeling complex fMRI data. Similarly, integrating data collected from our bodily behaviors with cognitive architectures could serve to provide a more faithful representation of how perception is coupled to (or decoupled from) action.

An alternative to the ACT-R approach is provided by the sequential sampling models (McVay & Kane, 2012; Mittner et al., 2014) which are based on the assumption that sensory information is gradually being accumulated before it reaches a threshold and a decision can be made with respect to the course of action (Forstmann et al., 2016). The sequential sampling models also offer the possibility to account for actions being performed during episodes of mind wandering accompanied by perceptual decoupling, by acting on an autopilot.

In general, the computational models of mind wandering focus on simulated behavior in terms of the trade-off between accuracy and speed. As we have seen throughout the course of this chapter, our behaviors while performing a task can be more complex than reaction times and accuracy alone in that mind wandering is associated not only with a change in magnitude or the variability of any one type of bodily behavior, but rather with a systematic covariation of bodily behaviors (D'Mello et al., 2012).

Conclusion

In the course of this chapter, we have highlighted the impact of mind wandering on the tight link between perception and action. Our overview of existing findings shows that mind wandering may manifest as an attenuation in sensory-motor responses to the environment (e.g., more variable response times, more

complex – or more idle hand movements – and reduction in vocal adjustment to context). Moreover, it may be "embodied" through non-instrumental behavior, such as fidgeting and facial expressions, which could be reflective on an exploratory off-task state, serving to determine the next attentional state ("on-task" or "mind wander"). Finally, we discussed the importance of integrating bodily behaviors into computational models of mind wandering in order to better understand both the processes and the consequences of mind wandering in different settings.FundingThis work was supported by the Netherlands Organization for Scientific Research Veni Grant No. VI.Veni.191G.001 (to MF).

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Chapter 5
Reorganizing One's World: The Gestalt Psychological Multiple-Field Approach to "Mind-Wandering"

Gerhard Stemberger

Consciousness Does Not Wander; It Differentiates Structurally

The expression mind-wandering is misleading from the point of view of Gestalt psychology. If one understands by "mind" – as it is usual in Gestalt psychology as well as in other schools of thought – the totality of consciousness and thus everything phenomenally given (cf. Duncker, 1947; Tholey, 2018), then it is clear that consciousness does not *wander*, but it *differentiates* itself under certain conditions in a characteristic way: Where it primarily consisted of *one* phenomenal world, divided into *one* phenomenal ego and its phenomenal environment, now a second world separates itself from this one world, which is also divided into a phenomenal ego and a corresponding phenomenal environment. This second world is embedded in the first and is more or less closely interrelated with it. This is what happens in the mental processes that are conceptualized, with positive or even negative connotations, under such diverse terms as mind-wandering, daydreaming, imagining, fantasy travel, attention deficit disorder, dissociation, and so on. What is common to all the states and processes thus designated is that the person in question is in two places at once – he is in *one* place, at least as far as his primary body ego is concerned, and at the same time in *another*, where he is busy with quite different things. Even more: It is not one and the same person who is both there and thereabouts, but the person there can be very substantially different in its characteristics and capabilities from the person there.

There have been (and still are) attempts to measure the frequency of such states and processes of consciousness divided in such a way. The currently most cited study seems to be the one by Killingsworth and Gilbert (2010), according to which people are engaged in "mind-wandering" for almost half of their time in a waking state. Many valid methodological objections can be raised against this study by

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Killingsworth and Gilbert.[1] But at the same time, their global findings can be plausibly reconciled with everyday experiences and other research findings, at least in their global tendency. Whether one considers the 46.9% of the Killingsworth-Gilbert study to be a quantitatively valid figure for what is actually happening or not, observations and findings from the most diverse areas (in the school classroom, at the workplace, in traffic, in leisure time, in clinical contexts) indicate in any case that humans spend very large portions of their conscious lives in divided consciousness.

The View of Divided Consciousness as a Disorder

The different conceptualizations of divided consciousness reflect certain interests, which in turn are characteristic for certain areas of life. There are such areas in which a divided consciousness is considered annoying or even dangerous. It is considered extremely dangerous, for example, in the world of work when dealing with heavy or sensitive machinery or with risky procedures, in the medical field during surgical interventions, in work processes that depend on cooperation, and also in traffic. It is considered disruptive (at least for some of those involved) in many teaching situations, but also in leisure time in games and entertainment as well as in many situations of relationships and communication in which the demand is made to be 100 percent "present." The fact that certain manifestations of divided consciousness are classified as pathological should be critically reflected upon from which point of view and in whose interest these classifications are made; this caveat leaves undisputed that there are also cases of divided consciousness from which those affected suffer themselves and in which they need help (like the case of "maladaptive daydreaming," investigated by Somer (2002), post-traumatic "flashback" experiences, and similar problematic processes).

The contamination with very specific interests can be seen quite clearly in some conceptualizations of "mind-wandering." This is especially true for those approaches that postulate the exclusive focus on a specific task as the normal case or at least as the generally desired state, and consider wandering attention as a deviation from or disturbance of this desired state. From their perspective, "task-unrelated thoughts" and "stimulus-independent thoughts" disrupt the "attention network system" (e.g., Gonçalves et al., 2017), and attempts are made to understand these "sources of disruption" and develop appropriate concepts for overcoming them. This usually

[1] In this study, "mind-wandering" is seen and addressed merely as a process of thinking. So the "mind-wandering question" is formulated: "Are you thinking about something other than what you're currently doing?"), while the "happiness question" is "How are you feeling right now?" and the "activity question": "What are you doing right now?". These differentiations in the formulation of the questions are misleading and compromise the results of the investigation by not doing justice to the full experience in the secondary total field, which, just like that in the primary total field, does not consist only of thoughts.

includes the notion of a "competition" for a limited set of perceptual or realization resources that are "fought" for or that necessitate "filtering" of perceptual content (filter theories, starting with Broadbent (1958)).

The distinction between desirable and undesirable "mind-wandering" is not unwarranted in principle, but it requires disclosure of the frame of reference from which this assessment emerges.

However, the now wide variety of research and conceptualization of "mind-wandering" cannot be adequately addressed here. In the following, I will limit myself to outlining the specific Gestalt theoretical approach to these and related phenomena.

Main Features of the Gestalt Theoretical Approach to "Mind-Wandering"

The following characteristics of this approach are derived from theoretical and empirical research within the framework of Gestalt psychology:

So-called mind-wandering belongs to a class of processes and phenomena of consciousness which, despite all other differences, have the following common characteristics:

1. From the total field of consciousness – consisting of the experienced ego and its experienced environment – a second total field segregates, which also consists of an experienced ego and its experienced environment.
2. This segregated second phenomenal total field also consists not only of thought processes, but is a complete field of experience and behavior.
3. This separation is due to the fact that in the experience of a person facts occur which are incompatible in one and the same world of experience for the person concerned in the given situation and enforce the segregation of a second world of experience; conversely, a multiple-field structure of consciousness can dissolve if in the experience facts occur which demand a unified total field. Both cases are due to the Prägnanz tendency.
4. The experience of non-Prägnanz that underlies this segregation is dependent on specific circumstances, which may be personal, cultural, social, and organismic.
5. Different degrees and forms of experiencing reality and irreality can play a central role.
6. Such a segregation of a second total field can be brought about willingly to a certain extent, but it can also occur unwillingly.
7. This segregation may occur abruptly (e.g., so-called flashbacks) or gradually, immediately, or via the intermediate stage of "overlapping situations."
8. Specific conditions can be formulated for the occurrence of the segregation just as they can be formulated for the reversal of the segregation.

9. There is a more or less close interrelationship between the two total fields, the forms and intensity of which depends on conditions that can be named and verified.
10. The occurrence of the segregation as well as the interaction of the two total fields and the reversal of the field division can, under certain circumstances, take on pathological features or be an expression of pathological developments. However, positive effects of the multiple-field structure can also be observed, which enable an operative use of the knowledge of these processes for therapeutic, creative, problem-solving, learning and teaching, and other purposes.

The Concept of the "Total Field"

According to the German Gestalt psychologist Wolfgang Metzger, the term "total field" is used in Gestalt theory for experiential situations in which the ego as an observing, experiencing, acting subject is involved in the experience (Metzger, 2001, 194ff). What is meant by this is the totality of the perceptual, imaginative, experiential, and behavioral world of the human being, i.e., his phenomenal world at a given point in time.

In perception research, the object and conditions of the investigated perceptual fact are usually selected in such a way that one can assume that the just given personal condition of the observer does not play a decisive role for the process of perception under investigation. Thus, the subject is, so to speak, faded out, and the field of perception is reduced to the object side. One then examines the various phenomena on this object side, as was done, for example, in Max Wertheimer's dot pictures for the demonstration of elementary Gestalt factors or "Gestalt laws" (Wertheimer, 1923).

In fact, every situation of perception always includes both sides, the perceiver and the perceived and the subject pole and the object pole. Therefore, it is inadmissible and impossible to exclude the subject pole of the field in all lifelike situations. For such perceptual and experiential situations, Wolfgang Metzger has coined the term of the phenomenal total field: It includes not only the object field of perception (and of action and behavior) but also the perceiving and acting subject in their interrelation and interdependence (Metzger, 2001, 194).

According to the Gestalt psychological view, this phenomenal world shows dynamic peculiarities as they are known from the field concept in physics. According to this, the facts that exist in this phenomenal world simultaneously are mutually dependent on each other in a dynamic relationship. What happens at one place of this field can cause changes at all other places of the field. This also underlies the well-known formula Kurt Lewin uses to capture the interdependence of person and

environment: Behavior is a function of person and environment.[2] This does not mean an "objective" person in an "objective" environment, but the environment experienced by the person in dynamic interaction with the experienced person. With Kriz, one can therefore also speak of behavior as a function of subject and lifeworld (Kriz, 2018, 229; cf. Kriz, 2017).

Gestalt psychology does not share the view according to which man always experiences himself as the center of his world. According to Edwin Rausch, the total field of man can rather be distinctively object-centered or subject-centered or show all possible transitions and different ratios of weighting with regard to the participation of object and subject (Rausch, 1982, 25f). Also, the separation of a second total field can take its starting point either from the object side, i.e., from peculiarities of the environment, or from the subject side, i.e., the situationally given constitution and aspirations of the person, or also from peculiarities of the relation between person and environment. The first description of a "twofold total field" goes back to Edwin Rausch (Rausch, 1982); he made this discovery while investigating the psychological processes during the viewing of pictures, but it is not limited to the situation of viewing a picture.

The Formation of a Second Self and Its Associated Environment

Edwin Rausch was able to prove in his investigations that under certain conditions, a second experienced ego with its own environment is formed within the primary total field of a human being (think, e.g., of a person who is so engrossed in a novel about the Middle Ages that he experiences himself as a knight in a medieval world while his primary ego lies comfortably in bed). Under such circumstances, therefore, a second total field separates out from the primarily given total field – we call it a *secondary total field* in Rausch's terminology. This secondary, just like the primary, total field consists of subject and environment in interdependence.

This discovery of such a twofold field structure by Rausch has two precursors in perceptual psychology. They each anticipated one or the other side of this discovery: the Danish psychologist Edgar Rubin (1886–1951), the emergence of a second ego, and the Belgian psychologist Albert Michotte (1881–1965), the emergence of a second environment.

Edgar Rubin referred to the observation of the emergence of a second ego during the contemplation of a picture in 1915 (Rubin, 1915/1921). Thus, he described that during close observation of a picture, in one's own experience, it is not the gaze that wanders along the contours in the picture, but a "pure ego" that has "nothing to do

[2] A frequently cited field definition in this sense goes back to Kurt Lewin: "A totality of simultaneously existing facts which are conceived as mutually interdependent is called a field" (Lewin, 1963, 273). Lewin refers to Albert Einstein for this definition, though the 1933 paper by Albert Einstein that Lewin cites contains no such field definition.

directly with the body or with the external, physical ego" (Rubin, 1915/1921, 153). If one compares these phenomenological findings of Rubin with the later ones of Rausch, the difference that emerges is that only Rausch grasps the consequence of the formation of this second ego: namely, that this second ego also possesses its own second environment, with which it forms a second phenomenal total field.

This difference is of great importance. When the "pure ego" Rubin speaks of (he obviously means a disembodied, "immaterial" ego – Rausch later uses the term "virtual ego" for special cases of this) wanders along the contours in the picture, this wandering has a direction in a picture space whose coordinates do not correspond to those of the space in which the body ego of the picture viewer is located in front of the picture. While the body ego of the person viewing the picture is standing still in front of the picture, his "pure ego" is in a directed movement within the space opened up by the picture, from left to right, for example, or from top to bottom, or even into the depth of the pictorial space. It is thus located and behaves in a different world than the viewer standing in front of the picture. In many deliberately induced variants of "mind-wandering," such as in many daydreams, in the experience of cinema and theater, but also in certain training and preparatory settings in sports, to name just a few, it is precisely this formation of another self in another world that is strived for.

In the investigations of Albert Michotte (1948a, b, 1953/1991, 1960/1991), on the other hand, the "duplication of space and time" is elaborated, which can be phenomenally observed in the viewing of images, in theater and film performances. Thus, instead of the emergence of a second self as in Rubin's work, what is at issue here is the segregation of a second world that has its own dimensions of space and time. Referring to Michotte's research, Mausfeld speaks of the phenomenon of a "multiperspectivity" as a "genuine perceptual phenomenon" that is "not based on a 'cognitive,' interpretive act of seeing something as something else" (Mausfeld, 2013, 12; see also Mausfeld (2011)). Again, the difference with Rausch's later discovery is evident: The concept of multiperspectivity implies an ego that can take different perspectives, but not necessarily the doubling of the ego, each of which in turn can take different perspectives in its own total field. This state of affairs in its entirety is only grasped by the multiple-field approach.

The Prägnanz Law as the Basis of the Multiple-Field Structure

"Psychological organisation will always be as 'good' as the prevailing conditions allow" – this is how Koffka summarizes the Prägnanz principle of Gestalt theory in a simplified way (Koffka, 1935, 110). What is meant by this "as 'good' as the prevailing conditions allow" was concretized by Edwin Rausch in 1966 in seven dimensions: (1) regularity or conformity to rules, as opposed to randomness or arbitrariness; (2) autonomy and independence, as opposed to derivation and

dependency; (3) integrity and completeness, as opposed to lack and incompleteness; (4) structural simplicity as opposed to structural complexity; (5) complexity and structural richness, as opposed to structural poverty; (6) richness of expression as opposed to poverty of expression; and (7) fullness of meaning as opposed to absence of meaning" (cited from Luccio (2019, 265f)).

According to Gestalt psychology, dynamic laws are responsible for the segregation of individual objects and object groups in the field of perception, but also for all other structuring processes in experience and behavior, in thought and imagination processes, and in language and other life processes. These laws have become known as Gestalt laws and can be summarized in the overarching concept of Prägnanz. This concept concerns the lawful regularities of organizing processes, which are not steered or determined from the outside, but take their course in a self-organized manner.[3] These regularities determine not only the division of the total field into an experienced ego and its environment with individual sub-areas, objects, and processes but also the cohesion of this total field or even the segregation of a further total field (or more than one) within the primary total field.

For the emergence of a second total field, Edwin Rausch refers to fundamental facts of perception: "Among the laws of the organization of the optical field of perception derived by Max Wertheimer (1923) on plane point and line figures, (...) a factor of sameness plays a great role: The division of the field of vision takes place in such a way that ceteris paribus like (similar) objects are seen as belonging together, unlike (dissimilar) as not belonging together. This factor can be transferred mutatis mutandis to the case of field splitting: what has been established for the division of the field Tf [Tf = Total field] that remains unsplit (...) also applies to the splitting into Tf_1 and Tf_2, if the concept of sameness or similarity is replaced by the more general one of fitting together, the concept of dissimilarity or dissimilarity by the more general one of not fitting together" (Rausch, 1982, 300; transl. GSt).[4]

Such a segregation thus takes place when circumstances occur within the total field which are incompatible within one and the same total field. This incompatibility does not depend on these single facts as such, but on the total situation of which these single facts are just a part. The same individual facts, which are compatible with each other within a game or fairy-tale situation, can be absolutely incompatible with each other in a situation which is perceived as more real (see the discussion of the reality problem later in this paper).

[3] Metz-Göckel suggests speaking of auto-organization rather than self-organization in most of these cases, "because there is no instance that ist he organizer as the term 'self' suggests" (Metz-Göckel, 2019, 30; tansl. GSt).

[4] In today's literature on visual perception, but also on areas of application such as typography, design, and layout, the Gestalt laws and the overriding Prägnanz law are usually only referred to individual figural objects or object areas. In Gestalt theory itself, the Gestalt theoretical construct of Prägnanz tendency was initially also elaborated and researched primarily in terms of such cases of object perception; but the scope of the Prägnanz principle was always understood much more broadly (cf. Metzger, 1982/1986 on the possibilities of generalizing the Prägnanz principle). For the controversial discussion of the Prägnanz principle among Gestalt psychologists, see also Kanizsa and Luccio (1986), Luccio (2003, 2019), and Koenderink et al. (2018).

However, our understanding of the effect of the Prägnanz principle in multiple-field segregation would be incomplete if we limited it to the phenomenal field alone. The phenomenal field is itself *embodied* as part of the psychophysical field and is also in constant exchange with the physical environment of the organism via the organism. Into the organism and its physical environment, the phenomenal processes act out, and from it they also receive "feedback," a control process of a cybernetic kind running in both directions. For this psychophysical organization, Wolfgang Metzger has used the term "steering function of our perceptual world" (Metzger, 1972). The principle of Prägnanz itself is not to be understood as a merely phenomenal principle, as Wolfgang Köhler emphasizes in a letter to Abraham S. Luchins in 1951:

> In other words, a fully adequate treatment of Prägnanz in individual cases seems to be possible only in physiological terms, because the functional whole of which we have to take account extends farther than the seen object. In the earlier years of Gestalt psychology we have overlooked this. ... Parts of functional wholes may have to develop in one direction or the other because only in this fashion Prägnanz can be reached for the total wholes (Köhler, 1951/1993, 297).

Thus, when we speak of the incompatibility that leads to the segregation of a second total field from the primary total field (or on the other hand to the dissolution of the multiple-field structure), we should not think of a mere phenomenal incompatibility. For example, "feedback" from the organism and its physical environment can undermine the multiple-field structure insofar as they force a disbanding of the secondary ego and thus of its secondary environment (think, e.g., of the urge to urinate that pulls one out of the dream, or a loud bang that intrudes into our daydream and is incompatible with its scene). Also the characteristic differences between the primary and the secondary ego and between the primary and the secondary environment have predominantly to do with the differences in their "embodiment."

Laws of the Multiple-Field Structure

We want to discuss the laws of multiple-field structure in more detail on the basis of the elementary division of the total field into an experiencing and behaving ego and its experienced environment. As a rule, ego and environment are mutually dependent on each other as dynamically interdependent areas of the total phenomenal field. Only in rare exceptional cases there are states of consciousness in which temporarily a phenomenal world without an ego is given (such an exceptional case is described by Koffka (1935) using the example of a mountain climber who lost consciousness after a fall into a crevasse and later described such a short egoless state when regaining consciousness; Koffka, 1935, 323ff). Apart from such exceptional situations, survival of the human organism would not be possible without the presence of a phenomenal ego in its phenomenal world. The ego-world division of the phenomenal world is elementary for the steering function that the phenomenal world has for the movement and survival of the human organism in its environment

(cf. Metzger, 1972, The Phenomenal-Perceptual Field as a Central Steering Mechanism). However, this steering function would also be severely impaired if there were two equal-ranking egos in this phenomenal world, both of which simultaneously attempt to "steer" the organism. The occurrence of two equal-ranking egos in a phenomenal world is therefore, as a rule, incompatible and brings about the segregation of a second total field, in which this second phenomenal ego is located in its own second phenomenal environment.

As an illustrative example, I introduce one of Volker Bußmann's graphics used by Rausch for his research (see Fig. 5.1).

This graphic is perceived very differently by viewers, sometimes also by one and the same viewer alternating in one or the other variant one after the other. I show two variants in Fig. 5.2a, b, in which I have drawn the "implicit viewer" with his "gaze ray" for clarification. However, this "implicit viewer" is not the person (ego_1), standing in front of the picture hanging on the wall in the exhibition room ($environment_1 = E_1$), but a segregated second ego (ego_2, as a rule "bodyless"), viewing the things within the pictorial space ($environment_2 = E_2$).

What interests us here, however, is not so much the diversity of the ways in which this graphic can be seen, but what these different possibilities have in common, namely, the formation of a second experienced ego (a second observer ego) within a second experienced environment, a second phenomenal world.

Figure 5.3 is intended to clarify how this is meant. It completes the variant drawn in Fig. 5.2a:

In Fig. 5.3,[5] the phenomenal world of the image viewer is drawn into the image viewer's head. In it, on the left side, one sees the phenomenal person looking at the picture; we call him according to Rausch's nomenclature ego_1; he is located in his phenomenal environment E_1 in which he sits on his chair; his gaze is directed at Bußmann's graphic IV projected on the wall. Vividly experienced ego and vividly experienced environment form a total field; we call it in Rausch's sense the *primary total field* or Tf_1.

At the same time, however, another world has separated from his phenomenal world, a *secondary* total field of a completely different kind, a second ego with a second experienced environment – ego_2 and E_2 – forming together the Tf_2. The otherness of this second world with its second ego is already shown by the fact that in this world the ego has a different orientation in space, its ray of vision goes downward, it also has no picture in front of it, but a collection of boxes, etc.

[5] The total psychophysical context is only incompletely indicated here: The picture drawn in the head area represents the phenomenal world of the person. According to Gestalt theory, the phenomenal world arises in an area assumed in the cerebrum, the psychophysical level (PPN). The arrows pointing to the organism from the outside symbolize the physiological stimuli that are conducted to the PPN via the neural pathways. The arrows pointing upward inside the organism symbolize the inputs to the PPN via the proprioceptors as well as via the trace fields in the brain corresponding to memory. Thus, only the "input side" of the total psychophysical context is indicated here. A complete account of this view, which we endorse, can be found in Bischof (1966, 28f).

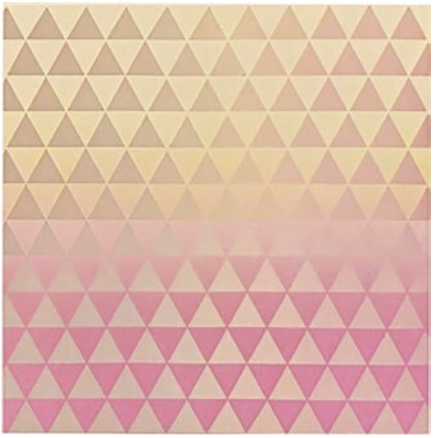

Fig. 5.1 Graphic IV by Volker Bußmann, supplement to Rausch, 1982

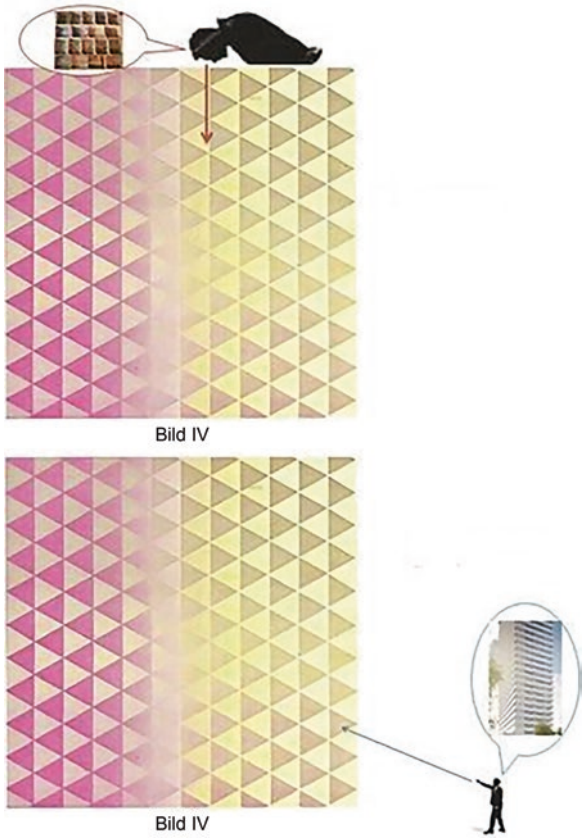

Fig. 5.2 (**a**) "Virtual viewer" ego_2 in E_2 looks from above and sees "boxes". (**b**) "Virtual viewer" ego_2 in E_2 looks from the side at the bottom right and sees "high-rise building with loggias"

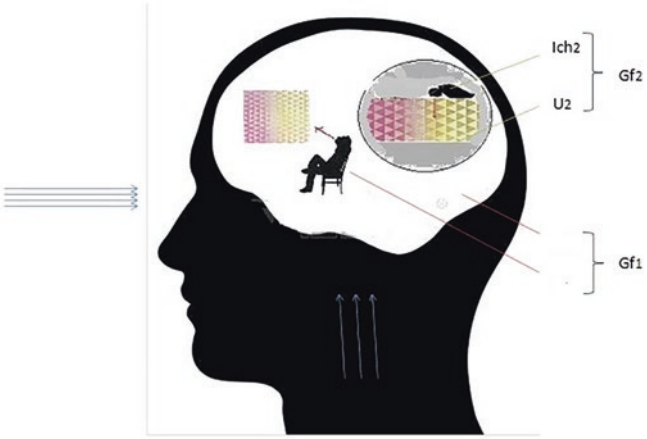

Fig. 5.3 Tf_1 (in German Gf_1) = primary total field with ego_1 (Ich_1) and environment1 (E_1; in German U_1); Tf2 = secondary total field with ego_2 and E_2 (see the supplementary explanations in the footnote 5)

This example shows at the same time one of the possible constellations of conditions which can promote or bring about the segregation of a second total field: If the ego experiences itself simultaneously in two different spatial positions and spatial orientations, the segregation of a second ego in a second phenomenal world almost always occurs. As a rule, we do not accommodate it in one world that our ego looks up and down at the same time, that it moves in one direction and at the same time in a completely different one, and so on. Where such facts, which are experienced as incompatible, occur or, e.g., are also intentionally introduced into our world, it comes to the segregation of a second experienced ego with its own second experienced world belonging to it.

However, multiperspectivity does not always lead to the segregation of a second world. Let us think, for example, of the various portraits Picasso painted of Dora Maar, who in these pictures is simultaneously oriented in different directions in space. This multiperspectivity of Dora Maar does not induce a segregation of a further total field in us. Only when we experience *ourselves* looking in different directions at the same time, this can occur.

In any case, as Bußmann's graphics show, the exclusion of a second total field in the viewing of images does not necessarily presuppose a pictorial world that is representational or that encourages objectification (as demonstrated above on the basis of the spectators' descriptions "boxes" or "high-rise building with loggias"). As recently demonstrated in a multi-year study of viewing Georges Meurant's paintings in a clinical psychotherapeutic context (see Fig. 5.4), appropriately designed pictorial spaces can also induce a multiple-field structure precisely by refusing figural objectification and instead inducing intense changes in the state of the ego,

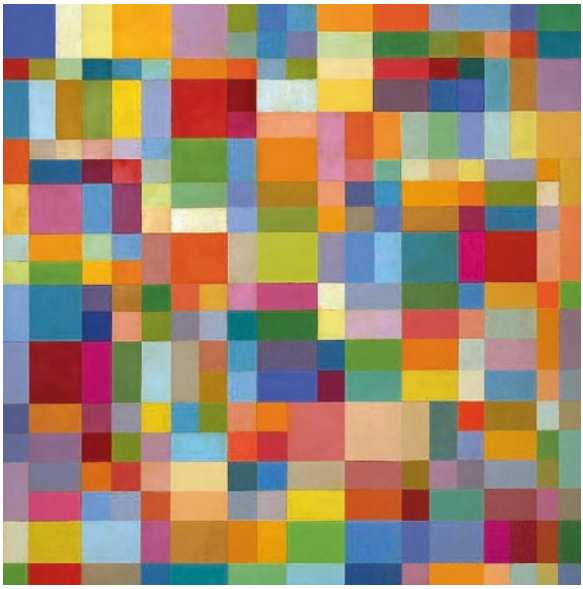

Fig. 5.4 Painting by Georges Meurant, 2008. (Reproduction courtesy of the painter; see also Georges Meurant Page http://www.gestalttheory.net/cms/index.php?page=meurant)

impressions of movement, and general boundary liquefactions.[6] These are able to set apart the ego_2 so clearly from the ego_1 that this alone induces a second total field (cf. also the discussion of Meurant's pictorial effects in Guiraud (1994), Argenton (2012), and Kitaoka (2012)).

The fact of the segregation of a second total field, which is shown with this example on the basis of the in-depth observation of a graphic or painting, demonstrates the basic principles which also show up in other areas of experience and behavior in a multiple-field segregation of the phenomenal world of a person:

In Stemberger (2009a) (also Stemberger (2009b)), the development of the formation and reversal of a multiple-field situation in the course of a psychotherapeutic session, both on the part of the therapist and on the part of the client, is analyzed. Examples of multiple-field segregation during a visit to the cinema (participation in the film event), from sports (anticipatory study of a Slalom course), from teaching (the student in love), and from dream experience (differences of lucid dream and "cloudy dream") are discussed in Stemberger (2018). Buchholz (2018) speaks of the possible role of linguistic and communicative processes, including the use of metaphors, in multiple-field processes. Kästl (2018) elaborates on further aspects

[6] Argenton: "Meurant's paintings, particularly, are very good – I would say very exemplar - examples of presence and functioning of dynamics principle of perception. As Rudolf Arnheim (1974, p. 412) writes: 'It turns out that every visual object is an eminently dynamic affair.' (...) These dynamic properties, inherent in everything our eyes perceive, are so fundamental that we can say: Visual perception consists in the experiencing of visual forces'" (Argenton, 2012, 1).

of the occurrence of multiple-field phenomena in psychotherapy and resulting possibilities. Fuchs (2010) analyzes the role of multiple-field segregation in eating disorders, Agstner (2012) on their potential for working with different altered states of consciousness in psychotherapy, Sternek (2014) on the use of the multiple-field approach in the application of screen techniques in psychotherapy, Zabransky (2014) on the importance of the multiple-field approach for dialogical work in therapy, Stemberger (2014) on impairments of multiple-field segregation by improper practice of "empty chair work" in psychotherapy, Turi-Ostheim (2014) on the role of multiple-field segregation for acting and acting classes, Trombini (2014) on the importance of multiple-field organization for understanding transference processes in psychotherapy, Semotan (2020) on the use of different multiple-field variations in psychodramatic fairy-tale play in psychotherapy, and Stemberger, 2020 – see above – on multiple-field phenomena when viewing paintings by Georges Meurant in a clinical context.

World Without Ego, World with Two Egos

However, experience shows us that not every appearance of a second ego is incompatible with the maintenance of a single phenomenal total field. There are cases in which in one and the same total field two or even more egos are experienced as quite compatible with each other in one world.

A few examples for such a coexistence of two egos: I in *front of the* mirror and I *in the* mirror and I *in the* photo and I as *viewer of* the photo. In these cases, the simultaneously appearing egos differ in that one ego is experienced as the "actual" ("true") ego, the second only as the image of this actual ego or of an earlier version of this actual ego. The first ego is experienced as the "actual" ego, and the second only as the image of this actual ego or of an earlier version of this actual ego. A doubling of the ego into an actual ego and an imaged or mirrored ego is quite compatible with each other in the reality of life of a person (who has outgrown earliest childhood) of our time and culture. (See, however, the research on the encounter with one's own mirror image in Bianchi (2005), Bianchi and Savardi (2009), and Arfelli Galli (2005).) "Original" and "image" may well share a common total field because they differ significantly in their "reality character": As "true to the original" as the image may be and as great as its influence on the observer's state of mind may be, it differs in its reality character (and effect) already by the fact that, unlike the original phenomenal body ego, it cannot control its physiological counterpart (the

limbs of the organism) by moving the phenomenal limbs of the second ego in the photograph.[7]

Another case of coexistence of more than one ego in *one* total field is the experience of a "façade" ego next to a "true" ego and the like. If in the case of mirror image and photography "original" and "image" of the ego are experienced as compatible in *one* world, in these cases, they are now different "sides" or "manifestations" of the ego. They result from different functions of the ego and are sometimes personified in the experience (e.g., "my inner child," "my inner swine," "my inner driver," etc.; cf. Henle, 1962). They may differ from each other to such an extent that the person concerned (and sometimes also the person meeting him) experiences them as two different egos; nevertheless, if we disregard rare psychopathological cases, their basic identity or belonging to *one* person is certain to him and he is also so accustomed to them that, as a rule, even in these cases, the tendency to Prägnanz does not force the segregation of a further total field due to the occurrence of several egos. The result is, rather, different possibilities of personification (with their own specific psychological function). This also results in various possibilities of "inner" dialogue in interaction with the "dialogue" of the ego with its environment (cf. Henle, 1962; Stemberger, 2010; Zabransky, 2014).

We come to another case of a multiple ego reported to us from lucid dream research. Lucid dreams are dreams in which the dreamer is aware of the fact that she or he is dreaming and at the same time is also aware of the fact that he or she can actively intervene in the shaping of the dream (Tholey, 1989, 1990). From reports of experiences with lucid dreams, it appears that in lucid dreams, it is sometimes possible to cut one's own dream body into parts, each with its own ego, even looking at each other, which could then develop again into their own complete dream bodies. Similarities of such experiments with certain shamanic techniques are evident, but need not concern us further here (Tholey, 2018, 214).

So there are states of consciousness in which a duplication of one's own body ego in one and the same world of experience is possible without forcing a segregation of a further total field. We find such states of consciousness in dreams and lucid dreams, but also under the influence of certain chemical substances (Leuner, 1962) or meditative and hypnotic techniques (cf. Agstner, 2012). The prerequisite in this case, in contrast to the aforementioned cases, is not a different reality character of the two egos, but a different reality character of the total situation. The reality character of the total field is different here due to a peculiarity of the psychophysical constellation; due to the extensive suppression of the central nervous feedback possibilities with the physical organism and its physical environment in sleep, hypnosis, intoxication, etc., the effect and feedback possibilities are so strongly altered

[7] For this concept of the perceptual/phenomenal world as a steering mechanism, see Metzger (1972). Cf. Also to Buchholz' comments on the different body reactions in different variants of reading aloud and conversation: "The body is involved in the scenes of narration as well as conversation" (Buchholz, 2018, 217). For the specific case of motion control and experience in front of the mirror, see Bianchi (2005) and Bianchi and Savardi (2009).

that the Prägnanz tendency can also enable otherwise absolutely "impossible" structures of the phenomenal total field.

The Role of Reality Experience

In summary, then, it can be stated: Even the appearance of a second phenomenal ego does not necessarily lead to the segregation of a second phenomenal total field. This is not the case if either the second ego has a different character of reality as the first ego (and therefore does not compete with the first ego for control of bodily action) or the phenomenal total field has a different character of reality due to the psychophysical total constellation as a whole, as it is the case with dreams and similarly altered states of consciousness.

Wolfgang Metzger suggests in his "Psychologie" (2001, 35ff) the distinction of different realities[8]: "Reality refers to (1) a transcendental, transexperiential world and (2) the totality of one's experiences. It further means (3) what is being encountered as opposed to what is merely represented. Finally, (4) objects, actions, thoughts, and feelings are all experienced as real, unreal or more or less real" (Brandt & Metzger, 1969, 127).

For our context, Reality 3 and Reality 4 are most relevant. A different experience of reality results from whether something is actually vividly encountered or only superficially remembered or imagined (Reality 3). That which is actually vividly encountered is usually more effective and stable, which shows in the stability or fragility of a simple or multiple-field division of our perceptual and experiential world. There are also different degrees of reality and qualities of reality (Reality 4). These in turn play a major role in what is and is not compatible for us in a single world (a single total field).

We can now generalize the role of the experience of reality and irreality for the segregation of a second total field in the following way:

The segregation of a second phenomenal total field within the perceptual and behavioral field of the person occurs when circumstances occur within the total field which are not compatible in *one* total field. This can arise spontaneously or be brought about deliberately, for which there are conducive and inhibiting boundary conditions. What is common, however, is the necessary condition that in a given situation circumstances occur or are brought about that are incompatible in *one* total field. What is compatible and what is incompatible has not only, but very essentially,

[8] The English-language presentation of these concepts of reality in 1969 shows a difference compared to Metzger's "Psychologie." Brandt and Metzger write: "This paper is based on the first chapter of Wolfgang Metzger's Psychologie (1969). We omitted the purely perceptional distinction of 'something or fulness as opposed to 'nothingness' or void which appeared as reality4 in that chapter but for which the concept of 'reality did not seem properly applicable. What is called reality in the fifth sense in the book is referred to as reality4 in the present paper" (Brandt & Metzger, 1969, 127).

to do with whether the common and simultaneous occurrence of two circumstances is experienced as realistic for the person concerned or not and whether the common and simultaneous occurrence of two differently realistic circumstances is experienced as realistic or not.

An example: The fact that in a film events of several years take place in one and a half hours, with time jumps into the past and into the future, has a different kind of reality than the everyday time experience of the moviegoer. The fact that a viewer of a painting showing a mountain landscape can look into the depths of the landscape, although at the same time he is quite aware that the painting is painted on a two-dimensional canvas, is also confronted with two different kinds of reality. Whoever asks himself the question "Am I dreaming or am I awake?" is perhaps likewise confronted with different realms and degrees of reality in one and the same situation.

Different manifestations of reality can play a role for this as individual facts or as qualities of the total situation:

In an undivided total field, areas of different degrees of reality or different degrees of reality can certainly coexist. One sees a photo of an attractive dish – although this picture can be very realistic, one does not get the idea of reaching for a knife and fork. One distinguishes quite clearly between different kinds of reality, without therefore splitting the total field. One sits in the theater and follows a bulky play with little interest and sympathy. The fact that the events on stage have a different character of reality than those in the auditorium is completely present and does not force a segregation into two total fields. One is told an implausibly inflated story. The tale seems absolutely unrealistic, but it has a place in an unsplit field of experience, in which lies and exaggerations can also have their place. One lies sleepless in bed and would like to "dream" oneself into a pleasant "memory scene" from the last vacation – but the desired separation of a second total field does not want to succeed, the professional worries experienced as more real and the laboriously unearthed vacation memories remain mercilessly united in one and the same total field.

With regard to the experience of reality and unreality, Albert Michotte has dealt in detail with the peculiarities of viewing paintings and films (1948a, b, 1953/1991, 1960/1991). If, for example, we stand in front of a painting that shows a landscape extending far into the depths of space, the phenomenon occurs that our perception of this three-dimensionality is in open contradiction to the fact of the two-dimensionality of the picture surface ("the new way of seeing the object is clearly incompatible with its insertion on a flat plane," Michotte, 1948a, 174). At the same time, the three-dimensional image space and the two-dimensional image surface differ in their character of reality, however not in a dichotomy real/irreal, but in a continuum whose poles they represent: "Thus, the character of reality can occur in various degrees. Phenomenally, the real and the unreal are not contrasted as contradictories in an all-or-none-fashion, therefore, but as limits of a continuous series" (Michotte 1948b, 184). Michotte concludes that the reality character of three-dimensionality increases to the extent that the bond to the image carrier (the paper on which the image is painted) decreases, which in turn depends on various factors.

"Consequently, when the represented object seems unreal, it is because of certain factors that tend to bind it to the plane of the paper on which it is drawn."

Differences in the experience of reality and their effects between children and adults as well as in different life situations were also researched early on by the research group around Kurt Lewin (cf. Brown, 1933; Mahler, 1933; Sliosberg, 1934). In this context, different behaviorally effective levels of reality were assumed, in which – as was experimentally proven – also different possibilities of experience and behavior are given.[9] These reality levels are not to be equated with the primary and secondary total field. Differentiations in the degree of reality and type of reality are rather possible in both total fields and can actually be found. Already in the primary total field, we find more or less (and also in different ways) seemingly realistic facts; to what extent we "tolerate" realistic and unrealistic next to each other in *one* total field is not only different between children and adults but also to a high degree different between members of different cultures and religious communities and in different life situations and needs (cf., e.g., Wright's considerations about the function of being "unrealistic," Wright, 1968).

Buchholz (2018, 226) points to a possible bridging function of linguistic and conversational facts of similar reality character – for example, of metaphors – between primary and secondary total fields. For instance, there would be a chance to "connect metaphor with Stemberger's multiple-field theory. We can form a metaphor if we can accommodate an element of one world in another world while not forgetting the difference (Buchholz, 2018, 226). This is consistent with observations on the bridging function of fairy-tale imagery in psychodramatic group work (Semotan, 2020).

In summary, one can state about the role of experienced reality and unreality:

The second total field has the more favorable conditions to segregate and maintain itself, the more real it is experienced. This again depends on the fact that as few as possible factors are in the game, which promote the binding to the Tf_1 and its stronger psychophysical anchoring. If one wants to promote the disassociation of a Tf_2, one must increase its degree of reality or factors must come into play which are suitable to increase the degree of reality or, vice versa, to decrease the degree of unreality of the Tf_2. But one can also lower the degree of reality of Tf_1 (e.g., by darkening, noise suppression, and soft seats, which reduce the body experience). Or turning into the realm of the pathological: If Tf_1 is experienced as more and more unreal, because lies and deception and confusion prevail there, and Tf_2, in contrast, appears more real than Tf_1, a relatively permanent disassociation of Tf_2 is fostered (with all consequences for the life situation; cf. Fuchs (2010) on cases of permanent Tf_2 segregation in eating disorders; the research on maladaptive daydreaming by Somer and colleagues, cf. Somer, 2002).

However, it is probably better to speak not of gradations in the degree of reality, i.e., quantity, but of different *kinds of* reality, i.e., quality. More research is needed.

[9] For example, Beatrice Wright: "behavior occurring on more irreal levels reflects the needs of the person more accurately than does behavior which is more definitely confined to considerations of reality" (Wright, 1945, 229).

The Role of Tension Systems: Need, Quasi-Need, and Attention

Once two total fields have emerged, these total fields are intertwined with each other and usually stand in a figure-ground relationship to each other. A person lies in bed and immerses himself in an exciting book. The scenes described become more and more vivid for him, and he begins to feel and experience with one of the characters in the novel – a second self in another world and thus a second total field are formed: On the one hand, there is the person still lying in bed with the book in his hand, but there is also already another who is entangled in exciting events in a completely different world.

Depending on the focus of attention, either the first or the second total field will be thematic or dominant (become the figure), the other thematically subordinate (form the ground). Thus, over a longer period of time, the fascination of reading will make the second total field the dominant one and the person concerned will hardly be aware that there is also the reader lying in bed. But there will be a shift of weight from this second total field to the first one, for instance, when the reader's fatigue becomes greater and he begins to feel it, or he begins to get hungry or to feel an urge to urinate. Even then, the two total fields will perhaps continue to exist for some time, with the attention swinging back and forth and thus changing dominance ratios, until at some point the second one dissolves completely under the increased pressure of need in the primary total field.

Attention alone, however, is not able to answer the dominance relations between the total fields – the decisive factor is rather the mentioned need tension. According to Gestalt psychology, human behavior and experience are dynamically determined to a large extent by the tension systems in constant flux, which arise from the needs and intentions ("quasi-needs") of the respective human being and orient the field events. This is also shown in the multiple-field segregation: If, for example, the primary Tf_1 is determined by the strong tension system of an unfinished situation, the attempt to escape into a reasonably stable Tf_2 (e.g., into a pleasant dream) has bad chances. Everybody who has turned sleepless in bed for hours in such a situation can tell about this from his or her own experience.

Characteristics of the Primary and Secondary Total Field

Primary and secondary total fields have a number of characteristic differences:

The primary total field: The body ego in the primary total field (primary ego, ego_1) is, in contrast to the body ego in the secondary total field (secondary ego, ego_2), precisely determined in its localization and usually fixed in its place by the body senses and by more powerful optical means. The same applies to the various facts of his phenomenal environment, the objects in space, etc. (cf. also Rausch, 1982, 27). On the whole, the primary total field is usually more psychophysically

anchored. This is true not only for the body ego_1 but also for the phenomenal environment of the ego_1 – it, too, is more intensively coupled with the physical environment of the organism by corresponding cybernetic processes than this can be the case for the phenomenal environment of a Tf_2.

The secondary total field: The secondary total field is generally more flexible and more easily changeable than the primary one. The secondary ego (ego_2) can be both "bodiless," i.e., in a certain sense point-like (e.g., a virtual observer ego), or extensively shaped as a naturalistic body ego. This ego_2 is even able to merge with the body-you of another person (for instance, in a narrated scene) and to experience the narrated and vivid scene from within the other person. The same is true for the secondary phenomenal environment. Whereas in the primary environment it can hardly happen that new objects and persons abruptly appear in the room, this is not at all unusual for the secondary environment. Numerous processes in psychotherapeutic situations are based on these characteristics of the secondary total field and the phenomena associated with it.

From these characteristic differences between the primary and the secondary total field, concrete consequences and possibilities also arise for the practical handling of these phenomena and processes. For this purpose, again some references to the psychotherapeutic field of practice:

The higher plasticity of the secondary total field due to its differently developed psychophysical embedding offers special starting points for much more far-reaching and perhaps also more surprising variations in all areas of the secondary ego as well as of the secondary environment than is the case in the primary total field.

The higher degree of fixation of the primary total field in turn, in particular the anchoring of the primary ego through its bodily senses, can be used specifically, for example, to "bring back" the client by shifting attention to the body perception of its primary ego and to its sensory contact with its primary environment. Similarly, strong stimuli from the environment have an effect in the primary total field, such as loud noises, noticeable movements of the therapist, and the like (cf. Kästl, 2018).

The reference to the different psychophysical anchoring of the primary total field must not be misunderstood in the way that the secondary total field would be a psychophysical "no man's land." Also the processes in the secondary total field are not "merely phenomenal," but just as psychophysical as those in the primary total field, in which they are embedded. The difference is only that their connection with the executive function and the feedbacks with organism and physical environment are of a different nature.[10]

[10] Gallagher (2015) points to corresponding research findings at Stanford University (the "Jane Austen experiment" by Natalie Phillips): "The results have shown that brain activity goes far beyond differences in 'executive function' or attentional mechanisms. Absorbed or immersed reading of Jane Austen showed activation of areas across the entire brain-not just language areas and attention areas, but also 'areas associated with physical activity and movement, parts of the brain we use to place ourselves spatially in the world, as though the readers were actually physically present in the story' (Natalie Phillips, cited in Thompson & Vedantam, 2012). It seems that it's not just the whole brain that is involved, but that changes in experiences of self and environment are involved" (Gallagher, 2015, 130).

Notes on Applications

The separation of several simultaneously existing total fields, which interact with each other, is in any case not a theoretical construct, but a phenomenal fact, which every human being is able to experience and validate. Whoever is attentive to this will come across many variations of the formation of a second total field, of the relevant conditions, of the interactions between the total fields, and of the changes in their parts and areas already in the self-observation in everyday situations.

On this basis, a multiple-field approach for grasping and understanding essential processes and for appropriate action in the psychotherapeutic situation can also be developed, as I have proposed (Stemberger 2009, 2018). In many psychotherapy methods, although without the theoretical and conceptual embedding elaborated here, techniques and forms of intervention are used that are suitable to stimulate, in one way or another, the segregation of a second total field in clients. Here and there, the characteristic differences between primary and secondary total field are also used selectively. This is especially the case in the phenomenologically, hermeneutically, and experientially oriented methods, although not limited to them. Corresponding techniques and forms of intervention include asking clients to recount remembered experiences in the present tense; to draw, pose, and enact dreams, fantasies, or remembered events; the Gestalt therapy technique of the "empty chair"; the catathym-imaginative techniques; and many others.

Thus, in a number of forms of therapy, something like "multiple-field techniques" are applied on the client side, while the corresponding methodical reflection of what happens on the therapist side is usually missing. The spontaneous or even consciously induced formation of a second total field in the therapist in connection with the client's narratives or enactments and the mutual influence of these multiple total fields would, however, deserve much greater attention than is usually the case in theoretical conceptions of the therapeutic process. (Also, when transferring the multiple-field approach to other areas, such as teaching, it should by no means be overlooked that not only the pupils or students should be considered but also multiple-field segregation on the part of the teachers). These processes, after all, form the basis for numerous phenomena that are meant when one speaks of "empathy" with the other, of understanding the other, and the like – but also for numerous phenomena that have entered psychotherapeutic terminology as transference and countertransference, as identification, projective identification, and so on and so forth.

In order for the experience of non-Prägnanz to come about and take effect as a prerequisite for the segregation of a second total field, certain conditions must be fulfilled, depending on the concrete situation. In most of the cases we considered, a decisive condition for this was a certain temporal duration, quality, and intensity of dwelling in a situation of looking at, reading, imagining, concentrating, or generally expressed: engaging oneself. However, this need not always be a volitionally induced or controlled event. The "overlapping situation" described by Kurt Lewin often plays the role of a preliminary stage or transitional situation in these

processes, which only at a certain point "tips over" into the separation of the second total field (if there is not a disturbance of the process beforehand). Such cases, which also correspond to the cases of image viewing examined by Edwin Rausch, are, however, opposed to others in which a "lightning-like," transitionless jump into the segregation of a second total field can occur. This is known, for example, in the field of psychotraumatology under the name of the "flashback."

For the reverse case, namely, the dissolution of a second total field and the return into an undivided primary total field, concrete conditions for the respective situation in which this occurs can be determined in the same way. Fundamental here is naturally the abolition of the experience of non-Prägnanz – be it by a fading out or disappearance of certain facts from experience, which were not compatible with each other in one undivided world, be it by a shifting of such facts to the level of unreality, on which they are compatible in one world, and the like. Willfully, such processes of dissolution of the second total field can often be brought about by shifting the attention to the experienced body (for more details, see Stemberger (2009)).[11]

In psychotherapy, people like to ask about the interrelation of such "parallel worlds" and quickly the idea emerges that an integration of such worlds is pending here. But not everything should belong together and not everything should be integrated at once: Let us think, for example, of the disassociation of traumatic experiences that have not yet been overcome, whose sudden breakthrough as a "flashback" can be particularly dramatic and agonizing for those affected. But also in other contexts, self-protection can be at play and prevent an integration of two worlds that are more or less separated from each other (for certain cases of so-called anorexia, Thomas Fuchs has proposed this understanding; Fuchs, 2010).

In our opinion, the multiple-field approach presented here only in its basic ideas (for more details, see Stemberger (2009)) offers new possibilities of a better founded and thus less one-sided approach to a multitude of phenomena, which are currently not regarded as a coherent field of research at all, but are dealt with under the most diverse aspects and headings. I mention here, for example, the preoccupation with "mind-wandering" (overview in Mooneyham and Schooler (2013) and Ergas (2017)), with imagining (see Pope and Singer (1978) and Singer and Singer (2005)), and with daydreaming (e.g., in Hopkins (2013) as a cause of traffic accidents, or in Somer (2002) and subsequent works as "maladaptive daydreaming"). There are also good reasons to believe that the phenomena underlying the so-called ego-state therapy (Watkins & Watkins, 1997) – as well as those of other approaches dealing with so-called dissociations – can be more adequately understood in factual terms using the multiple-field approach.

[11] The therapist's movement in the room can also contribute to this: "On the other hand, for the therapist, who may fear that the client will have difficulty, finding his way back 'into the therapy room, there is the possibility, through linguistic interventions or his own movements in the room, to let the first total field become stronger in both participants and thus supports the client not to 'lose' himself in the past, but to find his way back into the current therapy situation" (Kästl, 2018, 233).

I also consider the use of the multiple-field approach as promising for other fields of application, for example, for school and teaching, but I must leave it to those who are actively involved in these fields of experience. The remarks on the psychotherapeutic field may nevertheless have served as a stimulus for considerations about possibilities in other areas.

There is the estimate mentioned at the beginning, according to which humans of our time and culture spend about 30 to 50 percent of their time in a state of consciousness divided into several vivid total fields (Killingsworth & Gilbert, 2010; Kane et al., 2007). Killingsworth and Gilbert even refer to this as the "default mode of consciousness."[12] If such assessments are even approximately true, and this seems to be the case, is it not high time to question the state of affairs that most psychological theories of human experience and behavior completely ignore this fact and assume a consistently undivided state of consciousness in humans, which upon closer examination we must recognize as a fiction.

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[12] "Indeed, 'stimulus-independent thought' or 'mind wandering' appears to be the brain's default mode of operation" (Killingsworth & Gilbert, 2010, 932). By using the terms "stimulus-independent thoughts" and "mind-wandering," the phenomena addressed are theoretically classified differently, namely, behavioristically, than they are in the present paper.

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Chapter 6
Extended Minds and Tools for Mind-Wandering

Davood Gozli

Introduction

When I keep a diary for a while, I notice that my writing influences my experience outside the writing sessions. Keeping a diary means taking note of what happens during my days, recording and reflecting on whatever catches my attention. But these recordings take form in the *medium* of writing. Opening a space where I pay attention to daily events, where daily events are recorded in the form of written words, feeds back and changes how I experience the events on the following days. If I continue writing every day, eventually the quality of my observation changes. I notice more sentences forming in my mind. On the way to work, or while grocery shopping, or while cooking, or in the middle of a conversation, I catch myself in a state of mind that resembles writing. You could describe these experiences as "covert writing," as "writing in one's mind." You could describe them as a writer's approach to observing. You could also say my mind *wanders* toward writing, not only because of having cultivated a writing practice that is now available (as "somewhere" I routinely go and, therefore, can go with relatively little effort) but also because the writing is a medium in which my experience can be represented.

These observations are not unique to writing (Clark, 2008; Noë, 2015). We can discuss painting in a similar way. Learning to paint is not just about learning to move one's hand in a manner that is more controlled and refined. It is also about learning to *see* in a more controlled and refined manner, cultivating a painter's approach to experience. But the changes in seeing cannot occur without the effort to control one's hand. It is in the controlled activity of painting—or the activity of trying and failing to paint well—that we become more aware of what and how we see. The activity of painting opens up a space where we

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reflect on our visual experiences, representing our experiences in the medium of painting. Subsequently, when we encounter a scene, during a walk or while working or while looking at the face of a friend, our minds might *wander* toward how the scene would look as a painting, "painting covertly," or "painting in our mind." We might imagine the process of painting the scene. In other words, the practice of painting, similar to the practice of writing, makes it possible to mind-wander toward painting, to enter a state of mind that resembles the activities of painting.

We could extend these observations one further step, in order to emphasize another feature of the relationship between the mind and the media of representation. I have recently begun participating in social media (e.g., Twitter, YouTube). Similar to the influence of writing, which goes well beyond the writing sessions, I have noticed that my thoughts can now—without any planning on my part—take the particular forms that these media afford, even during the times I am physically disengaged from those media. A thought can occur to me in the form of a tweet, or in the form of an idea for a YouTube video. These media enframe and organize my experience. They also lay claim on my experience, generating the desire to package my thoughts into tweets or videos, to take my thoughts *elsewhere*. The digital media summon my private thoughts, urging them to become something else, to reach beyond here-and-now, to transform into something more public, more self-assured, more fixed, and more generalized.

We can derive at least two points from these observations. First, we cannot maintain a naïve distinction between, on one hand, an "autonomous" mind and, on the other hand, the tools and representational practices we use for understanding and expressing what we experience (Clark, 2008; Noë, 2015). The tools extend the mind and its representational ability. Once we acquire a skill like writing or painting, a way in which the perceptual world can be grasped and explored becomes available. These observations reveal certain characteristics of the mind, the mind's relation to media of representation, and the *space of mind-wandering* (MW) that opens up once we practice and acquire the techniques of a given medium, which in turn becomes "a tool" for MW. Second, it is not only the tools and techniques that are summoned and used by the mind. The media, the acquired techniques for engaging with the media, can also summon the mind, triggering MW without prior planning and intention. As such, tool use and technique do not necessarily come *after* a plan has formed in the mind.

Imagine a filmmaker (someone who has acquired the techniques of representing experience in the medium of film) having to wait somewhere without anything to do. Perhaps she is in the waiting room of a dentist's office. After a while, her mind drifts away from the ordinary way of seeing the waiting room and enter into an explorative mode of seeing that is shaped by her craft. Without planning in advance, she imagines recording a movie at that waiting room, or about waiting rooms in general, or about secretaries, or about people with dental problems. These are not tasks, but passing considerations. If the filmmaker in our example becomes sufficiently interested in one of these passing thoughts, she might turn it into a project,

but that is not necessary. A similar sentiment about how ideas come to mind without planning is described in a quote misattributed to Mozart:

> When I feel well and in a good humor, or when I am taking a drive or walking after a good meal, or in the night when I cannot sleep, thoughts crowd into my mind as easily as you would wish. Whence and how do they come? I do not know and I have nothing to do with it. Those which please me I keep in my head and hum them; at least others have told me that I do so (Dennett, 1996, p. 346).

Dennett goes on to say:

> Mozart is in good company. Rare is the novelist who *doesn't* claim characters who "take on a life of their own"; artists are rather fond of confessing that their paintings take over and paint themselves; and poets humbly submit that they are the servants or even slaves of the ideas that teem in their heads, not the bosses (Dennett, 1996, p. 347).

We might think the relationship between a person whose mind is wandering and the images and thoughts of MW is transparent to the person. An image comes to a painter's mind, we would think, because it is a possible painting—why else? More generally, we might think the possible "use" of images during MW is transparent to the person. This does not, however, need to be the case (Morley, 1998; Singer, 1981). That is to say, it is possible for MW to have a function that is not known to the person. In an evocative passage, describing Ivan Kramskoi's painting, "Contemplator," Dostoevsky, 1992, pp. 126–127) writes about the ambiguous relation between the passing thoughts of a daydreamer—portrayed in the paining—and what the daydreamer may or may not do. Dostoevsky uses "contemplation" to refer to the phenomena currently described as daydreaming or MW:

> [I]f he were asked what he had been thinking about while standing there, he would most likely not remember, but would most likely keep hidden away in himself the impression he had been under while contemplating. These impressions are dear to him, and he is most likely storing them up imperceptibly and even without realizing it—why and what for, of course, he does not know either; perhaps suddenly, having stored up his impressions over many years, he will drop everything and wander off to Jerusalem to save his soul, or perhaps he will suddenly burn down his native village, or perhaps he will do both.

In Dostoevsky's description, a person might go on daydreaming in a way that resembles collecting pieces of a puzzle. He might go on collecting such pieces for a long time, without knowing exactly why, and without knowing the big picture. He is collecting the images simply because those images "are dear to him." One day, he might suddenly see the big picture. As Dostoevsky's example suggest, the big picture might trigger action that is radically inconsistent with the person's history and what others expect from him. If we take this passage seriously, we will consider the possibility that MW can begin without a known superordinate intention, without being tied to a course of action, although we will not rule out the possibility of intentional or action-oriented MW. Whether or not MW is reflective and intentional might depend on how much of the "big picture" the person sees and whether or not he knows why the images "are dear to him." Accordingly, over time, if MW results in the accumulation of images that assemble into coherent whole, they might

suddenly compel the person into actions radically different from his existing social role (going on a pilgrimage, burning his native village, etc.).

In another example, Dostoevsky describes the transformation of MW through time, in the case of a fictional character, considering how the influence of MW on a person can change. To summarize the background, we read about a man who had committed a murder and escaped justice. To forget the murder, he occupied himself with work, philanthropic activities, a new romantic relationship, and so forth. For a time, his ephemeral MWs do not disturb him, until…

> … he fell to brooding at last, and his torment was more than he was able to bear. … [H]e began to picture a different dream—a dream he at first considered impossible and insane, but which stuck so fast to his heart that he was unable to shake it off. His dream was this: he would rise up, go out in front of people, and tell them all that he had killed a person. For about three years he lived with this dream, he kept picturing it in various forms. Finally he came to believe with his whole heart that, having told his crime, he would undoubtably heal his soul and find peace once and for all (ibid, p. 307).

The view offered in this illustration goes beyond viewing MW as a simple series of images and thoughts going through a person's mind. We recognize that the person's attitude toward those images, as well as the associated beliefs, can change. Although MW can be tied to goals (e.g., confessing to a murder, leaving one's native village), the person might go on entertaining these images without, at first, being aware of their significance. Similar to the practice of writing or painting, MW itself might continuously extend the domain of imagination. The person's relation to the content of MW, therefore, can range from unreflective and unaware (of the purposes signified in the images) to reflective and aware (Morley, 1998; Stawarczyk, 2018). From such a position, it would not make much sense to ask simplistic questions, such as "Is MW reflective?", "Is MW goal-driven?", and "Do people intentionally engage in MW?". The position that gives rise to such simplistic questions tends to be a position that has not yet examined the phenomena of MW in its richness and diversity (Gozli, 2019, 2020; Seli et al., 2018).

So far, we have followed the implications of certain practices, such as writing and painting, which lead to blurring the distinction between the mind and tools. In addition, we have considered that the mind's relation to its objects (e.g., "objects" of MW) could change, in a way that reveals new meanings and new goals (Tateo, 2020). I began with these threads, not only to separate my approach to MW from current experimental approaches but also to emphasize that the mind/tool deconstruction and the unreflective relation to goals both apply to experimental research. It is important to recognize that, analogous to how a painter's experience can be enframed by her acquired methods, researchers' methods can enframe their subject matter. Analogous to how a daydreamer is unaware of the significance of the images in her daydreams, researchers might be unaware of the goals associated (and excluded) with their methods. The methods of experimental psychology and cognitive neuroscience could be viewed as media of thought and communication. Experimental psychology of MW is itself enframed by the practices, assumptions, and techniques of researchers, which can conceal alternative ways of thinking about the topic. That is to say, the methods for the study of MW should themselves be

considered as tools for MW, and in terms of how they extend, shape, and limit our thinking about the topic of MW.

In the rest of this chapter, I will discuss two approaches to MW. The first approach, which is more popular in mainstream psychology, is a view that tacitly regards MW as a type of task-switching. That is not necessarily a conscious theoretical position, but rather the outcome of using methods that track MW with reference to task performance, as a deviation or switching away from it. According to this approach, our minds wander *away* from the task performance and that *wandering away* is an essential feature of MW. In contrast, the second approach regards MW, not as switching from a task to something else, but as a style of engagement. It so happens that this style of engagement is typically associated with disengaging from common tasks, particularly those used in educational and research settings, but the second approach does not regard disengagement to be an essential feature of MW. It is instructive to consider both approaches. I argue, nonetheless, that thinking about MW as a style of engagement *with* an activity, rather than as disengagement, leads to clearer theorizing.

Mind-Wandering as Task-Switching

Task performance is generally treated as a practical necessity for most experimental studies in psychology. On one hand, engaging with tasks renders participants susceptible to experimental manipulations. On the other hand, giving the same task to all participants in an experiment enables treating them all as members of the same category (Gozli, 2017, 2019; Wachtel, 1973). For example, in a visual search task, all participants are treated as people who are attempting to complete a search task. And given that they are completing the task, we can measure various aspects of their performance, such as the time it takes to complete the task, number of errors, and so forth, as a function of factors manipulated by the experimenters. Those measures are meaningful only under the assumption that participants are performing the task according to the given instructions, e.g., trying to search as rapidly as possible without compromising accuracy.

The role of experimental tasks as the engine of data production has resulted in the recognition that research participants might occasionally disengage from tasks (Callard et al., 2012; Gozli, 2019). This, in turn, has resulted in the emergence of research on MW, which begins by considering MW as deviation from task performance (Callard et al., 2012, 2013; see also Christoff et al., 2018). Using a task-switching metaphor, we could say that participants are switching from the task they are supposed to be performing, and covertly engage with another type of task (e.g., daydreaming). According to this approach, MW involves stepping away from the task or a failure to maintain control over task performance. Thus, the central role of the task persists in MW research. According to this approach, we can study and know about MW in so far as we observe its relation to task performance. In experimental situation, we must first identify the task, such that we know what it means to

be “on-task” and to identify some other states as “off-task.” Outside of the experimental situation, when researchers rely on distant communication with large groups of research participants (e.g., using a smartphone app), the meaning of “on-task” may be more ambiguous and dependent on the participants’ judgment.

For the sake of comparison, let us briefly return to our earlier examples of writing and painting. When we imagine a writer mind-wandering while waiting in line at the grocery store, or when we imagine a painter mind-wandering while walking in the park, we are not only interested in their disengagement from the tasks of waiting-in-line or leisurely walking. Both “tasks” allow for MW, as they are not particularly demanding (Morley, 1998). It is very likely, therefore, that these tasks will not be interrupted by MW. Indeed, our interest in these cases goes beyond whether or not the tasks are interrupted. We can turn to how the writer and the painter, while they are mind-wandering, relate differently to the same circumstances. If the writers’ mind is summoned toward writing, how are the grocery store items, the staff, or the people in line represented in the writer’s mind? How is the park viewed, imagined, and explored in by the painter? Knowing something about the persons, their skills and interests, our questions can go beyond *whether they are disengaged*, and address *how they are engaged*. We can ask about how they might be differently observing, imagining, or thinking the same situation (Tateo, 2020).

Why such interests are rare in current MW research? One reason is that researchers are interested in general attributes of MW, thus recruiting participants without inquiring about their abilities or habits that relate to MW, including their artistic and technical skills. Because these characteristics differ across people, and because they would complicate the design of a study, attention to them would present researchers with further difficulty. Moreover, the findings of such complicated studies, precisely because of the attention given to individual tendencies, would likely not turn into general claims about all people. The participants are, thus, treated in a uniformed manner, regardless of how or why they mind-wander. They are treated with regard to what they all share in common, namely, a task that is typically given to them by the researchers. From the perspective of the researcher interested in MW, what is then available as the target of investigation is participants’ possible performance in, or disengagement from, the task and any subsequent cost of MW on task performance. What remains as the target of investigation reflects the outcome of a series of decisions made prior to collecting any data (Valsiner, 2017). Such decisions give rise to research questions that are, at the same time, ambitious (since they inquire about *universal* properties of MW) and unambitious (since they exclude interesting psychological phenomena that require attention to persons).

Some attention to the type of task usually used in experimental studies of MW would be instructive. As a matter of convenience, it is generally preferable to use tasks that both enable the study of MW *and* increase the likelihood of its occurrence. If the task is highly interesting, the likelihood of disengaging from the task would be low (Silvia, 2008), which would not be desirable for a study of MW. One such simple and repetitive task is the so-called sustained attention to response task (SART; Robertson et al., 1997). Participants in this task perform a key-press response whenever they see a “go” stimulus and withhold responding whenever

they see a "no-go" stimulus. The "go" stimulus is presented more frequently than the "no-go" stimulus. For instance, in a task in which stimuli are drawn from the set of single-digit Arabic numerals (1–9), participants might be asked to withhold responding whenever they see "3" and respond when they see any other digit. SART is, therefore, a two-choice task, in which selecting a correct choice requires remembering the task rule and attending to the current stimulus. As such, MW can be reflected in incorrectly responding to a no-go stimulus.

There is, of course, more than one way to respond incorrectly on a no-go trial. Especially given that go trials are more frequent, the entire task could be approximated as a simple repetition task that consists only of "go" trials. According to the simple approximation of the SART, the instruction is: "Respond upon seeing *any* stimulus!". This approximation would be more efficient than the original task, though it occasionally leads to mistakes. Participants might make a mistake, without mind-wandering, if they are using the efficient approximation of the SART. It is possible that after adopting the task-approximation strategy, participants can more easily daydream (Forster & Lavie, 2009; Seli et al., 2016), but a subsequent disengagement from the task is not the same as the initial approximation of the task.

What might be taken as a sign of MW, therefore, might very well be a sign of engaging with alternative task rules. Likewise, expectation should be distinguished MW. Even those following the original task rules might occasionally expect, prior to seeing the next stimulus, that they will see a "go" stimulus. This expectation can also lead to error by reducing the decision threshold of responding. To address these possibilities, researchers have developed methods of distinguishing MW from changes in performance strategy (Seli et al., 2012, 2013b). These methods retain the spirit of the task-switching approach, because they are clearer about what it means to *not* mind-wandering (i.e., changing performance strategy) than what MW means.

Seli et al. (2013b, c) proposed an alternative to SART that does not include no-go trials. Participants respond to the beats of a metronome, attempting to keep their responses synchronous with the beats. The authors argued that deviations in RT can be used as a measure of MW. A possible problem with this solution is that removing the no-go trials makes the task more monotonous and predictable than the standard SART, which might in turn affect what is under investigation (Forster & Lavie, 2009; Seli et al., 2016; Zhao et al., 2013). In the metronome version of SART, MW is similarly interpreted as an insensitivity to, or disengagement from, task-related stimuli. In the standard SART, MW involves reduced insensitivity to the defining feature of the "no-go" stimulus, whereas in the metronome task, it involves reduced insensitivity to the rhythm (the repetitive rate of stimulus onset). One way of describing such insensitivity is to use the phrase "perceptual decoupling," which we ought to consider (Schooler et al., 2011; Smallwood & Schooler, 2006, 2015). We should pay particular attention to how perceptual decoupling fits within the task-switching approach to MW, emphasizing what the mind wanders *away* from.

In favor of the perceptual-decoupling view of MW, Weissman et al. (2006) found that increased response time, an implicit measure of MW, was associated with a decrease in visual-evoked activity in occipital areas. Other electrophysiological studies found a negative correlation between frequency of MW reports and

sensory-evoked P3 for both targets and distractors (Barron et al., 2011; Smallwood et al., 2008). Also consistent with the perceptual-decoupling view, Smilek et al. (2010) found a positive correlation between eyeblink rate prior to a trial and the likelihood of reporting MW. Smilek et al. (2010) reasoned that due to their effect on attenuating visual sensation, an increase in eyeblink could be a symptom of MW.

The limitation of the perceptual-decoupling view has to do with the type of tasks it presupposes, namely, tasks that require attention to some specified perceptual features. That is, for perceptual decoupling to mean disengagement from a task, the task must specify in advance the relevant features of the stimuli. Many tasks do not share these characteristics. When I am trying to commit a phone number to memory or calculate the number of days left until a deadline, I am attending to information that is perceptually absent, although I am not mind-wandering. Similarly, playing a game of chess involves attention both to perceptual objects and to plans, possible futures, tactics, and strategies that are not present on the board. Task engagement can, in many cases, narrow down attention to stimuli, because only a subset of what is perceptually available is relevant to the current activity (Bilalić et al., 2008; Eitam et al., 2013, 2015). Unless we limit ourselves to a particular type of task, the external-internal dichotomy does not map onto the distinction between being on-task and MW (Chun et al., 2011).

Another example can illustrate the limits of the perceptual-decoupling view. Imagine that we are instructed to look at a series of visual items and pay attention only to their shape (e.g., categorizing them as "square" or "circle"), even though the items vary in size, color, texture, and their accompanying sound. If we pay attention to colors, the sounds, while still keeping track of the shapes, are we perceptually less engaged with stimuli? It would be reasonable to regard attention to multiple features of an event as *more* perceptual engagement, compared with attention to a single feature of the same event. Even though we would recognize attention to irrelevant features as MW, we would also note that this instance of MW is associated with *more* engagement with the stimuli. In the well-known inattentional-blindness tasks, this would be the type of disengagement that can increase the likelihood of finding the "gorilla" (Simons & Chabris, 1999; see also Dreisbach, 2012). We should, therefore, qualify the perceptual-decoupling view. In tasks that require sustained attention to some task-relevant stimulus features, failure to sustain attention to those features would constitute MW. This circular description reveals that the perceptual-decoupling view is, in fact, less useful than it appears. It carries a view of task performance that tacitly identifies, in advance, MW with perceptual decoupling.

If MW cannot be defined as perceptual decoupling, how should it be defined? In general, the task-switching approach to MW maintains an obscure view of MW while tracking it with the help of (deviations from) task performance. How MW is defined in each study depends, to some extent, on the operational definition—which is communicated with the participants—within that study. More importantly, because MW is identified in distinction from task performance, the task-switching approach views MW as a unified set of phenomena. Consequently, given that MW is treated as one set of phenomena, we can begin searching for laws or lawlike

regularities, without a clear definition of MW. We might ask, "Is MW related to negative mood?" and "What do people think about during MW?" Pursuing such questions might result in taking contingent observations as general regularities (Smedslund, 2016), and expect replicability where replicability should not be expected. As Stawarczyk (2018) noted, what people think about during MW varies widely, ranging from positive to negative, self-related to other-related, and past-related to future-related. That is not to say that all these possibilities content is equally frequent, but frequency should not be confused with necessity. It might be possible that MW is frequently associated with negative mood (Killingsworth & Gilbert, 2010; Ruby et al., 2013), but such a finding reflects a fact that is historically and culturally contingent.

The instructions given to research participants about MW vary across studies. Weinstein (2018) reviewed 105 published articles and found 69 variations in their methods. Probes (e.g., "Where you mind-wandering just now?") differ with respect to the words used, the number of available options for response, which option is presented first, and so forth. The choice was binary in some studies (on-task vs. off-task), while other studies provided more than two options (on-task, task-related distraction, task-unrelated distraction, mind blank). When the term "mind-wandering" is used, experimenters and participants must come to some agreement about the meaning of MW, and the agreed-upon meaning might differ across studies. For example, Antrobus et al. (1970) instructed participants that feeling hungry during the experiment did not count as MW, though thinking about what to eat after the experiment did. Of course, avoiding a precise definition of MW and operating with an ambiguous concept of MW can also be agreed upon.

The instructions, including the working definition of MW shared by the researchers and their participants, as well as the features of the probe, might affect the frequency of MW reports. Weinstein et al. (2018) found that emphasizing on-task state ("Were you on task just now?"), as opposed to MW ("Was your mind-wandering just now?"), in the probe question, was associated with 10% decrease in MW reports. Seli et al. (2013a) found that MW reports increased with a longer delay between probes, though they interpreted this change as a change in decision criteria (i.e., the meaning of MW held by the participants), and not MW frequency per se. Robison et al. (2018) found no association between MW reports and the frequency of probe presentation, but they found a decrease in MW reports when the instructions distinguished between intentional and unintentional MW.

In addition to the instructions, task characteristics can also influence the frequency of MW. If the task is relatively simple, frequency of MW is thought to increase (Forster & Lavie, 2009; Seli et al., 2016). Motivation is another factor. Seli et al. (2017) compared MW reports across two conditions. In the "low-motivation" condition, participants received the standard instructions about how to perform the task. In the "high-motivation" condition, participants were told that performing accurately would allow them to leave the experiment earlier. MW reports were fewer in the high-motivation condition. Organization and coherence of the task is another factor that can affect MW frequency. For instance, Smallwood et al. (2003) found fewer MW reports, on average, when people read a list of words that belonged

to the same category, compared to when the words did not belong to the same category. Stated differently, weakly motivated tasks and disorganized tasks are effective tools for MW.

The correlations between MW and working-memory capacity should be considered in this context (McVay & Kane, 2009; Wiemers & Redick, 2019). The term "breakdown" is open to two different interpretations. First, it is possible that thinking about multiple goals is itself the "breakdown." According to this view, the breakdown occurs when the participant's mind begins to wander during task performance, regardless of any subsequent effect on task performance. Perhaps participants first disengage from the task because of their low WM capacity, after which they become susceptible to MW. Alternatively, it is possible that the breakdown arises *after* multiple goals have occupied working memory and that the breakdown is the inability to simultaneously pursue multiple goals. According to the second view, individuals with high working-memory capacity may mind-wander during the task, but their ability to think about multiple goals enables them to mind-wander without compromising task performance. Thus, low working-memory capacity might not make the onset of MW more probable, but instead increase the negative consequence of MW on performance.

Performance might suffer due to participants' inability to organize subtasks into a coherent whole (Smallwood et al., 2003). In fact, tasks that are used for estimating working-memory capacity include a task-switching component, requiring participants to keep track of multiple subtasks (Redick et al., 2012; Wiemers & Redick, 2019). This suggests that the measures of working-memory capacity might reflect, in part, participants' ability to be flexible in relation to multiple goals while at the same time persisting on a superordinate goal. According to both interpretations, individual differences in cognitive control cause differences in MW tendency, although the two interpretations characterize the causal connection differently. If measures of working-memory capacity cannot be clearly disentangled from measures of MW, any correlation between the two would be uninformative.

To summarize this section, the task-switching approach to MW begins with assigning participants with a specific task, which typically involves attention to a subset of available perceptual events and a clear stimulus-response mapping. These methods for the study of MW are themselves cognitive tools that limit the way researchers think about MW. The view of MW as task-switching is a consequence of the methods that take task performance (treated in an abstract and homogenous way for all participants) as their starting point. In particular, MW is believed to involve perceptual decoupling. This claim is difficult to justify in general, because many activities that involve an imaginative component might require perceptual decoupling (Tateo, 2020). Moreover, the task-switching approach maintains the impression that MW consists of a single set of phenomena (Gozli, 2019). This treatment of MW, which is a *decision* made in advance by the researchers, leads us to seek general laws or lawlike regularities about MW. Many of the findings reveal the unsurprising role of the methods for studying MW (e.g., tasks that are uninteresting, disorganized, and unmotivated are more likely to result in MW), rather than task-independent attributes of MW.

Mind-Wandering as Style

A second approach characterizes MW in terms of a style, rather than as a special type of task (to which the person would "switch"). Let me admit at the very outset that the purpose of this approach is *not* providing a unified definition of all kinds of MW that experimental psychologists have included in the category. Neither do I wish to defend the idea that MW is associated with unique, necessary, and sufficient attributes. Nevertheless, the style-based approach can, in my view, accomplish the following. First, it accounts for the fact that some phenomena are categorized as MW. Second, it identifies the essential feature of an important subset of MW phenomena without relying on task performance. Third, it clears the way for making further distinctions between phenomena, as well as using other (clearer) words for describing related phenomena. Given that I am addressing an existing field of research, I continue using the term MW, writing *as if* there is an identifiable referent for the term.

To begin, we can recognize that MW might not necessarily involve disengaging from the current task but involve a change in how the task is performed. What would happen, for instance, if you begin mind-wandering during a conversation? Could we conceive that you can mind-wander without leaving the conversation? If so, then your contributions to the conversation would become scattered, less relevant to what was said previously, or perhaps your contributions would cease to be parts of a predictable thread of thought. You might also pay attention differently to what your conversation partner says. Despite all these changes, you can still remain in the conversation. The distinction is similar to that between walking in a straight path toward a clear destination and walking around without a clear direction. We might even say that the practice of "free association" (i.e., speaking whatever comes to mind with honesty, without pause, or correction; e.g., Freud, 2003/1940) is an attempt to combine speaking with MW.

A description of the style-based approach to MW requires two additional theoretical pieces. First, we need to recognize the hierarchical organization of goals (Gozli, 2019; Gozli & Dolcini, 2018; Powers, 1998). Relatively subordinate goals (e.g., pressing a button on a "go" trial of the standard SART) serve relatively superordinate goal (e.g., continuing the task until completion). Second, we need to recognize the distinction between persistence and flexibility developed by researchers interested in cognitive control (Dreisbach & Fröber, 2018; Goschke, 2013; Hommel, 2015; see also Hills et al., 2015). "Persistence" describes a state in which the selected goal or action is strongly activated and competing alternatives are strongly inhibited. By contrast, "flexibility" describes a state in which the selected goal or action is weakly activated and competing alternatives are weakly inhibited.

Persistence and flexibility are styles of performance. Although MW cannot be associated with general flexibility (without regard to the distinction between super- and subordinate goals), flexibility at relatively superordinate levels of a goal hierarchy can be associated with MW. For instance, in the standard SART, flexibility at the subordinate level enables switching between "go" and "no-go" responses and

should not be equated with MW. Flexibility at the relatively superordinate level, at which task goals compete with task-unrelated goals, can be associated with MW. Similarly, we can distinguish errors that result from too much persistence at the subordinate level (what I previously described as task approximation), without calling them MW. MW is here conceived not in terms of disengaging from the task, but in terms of the weakening of the currently dominant superordinate goal. Compared to the "on-task" state, in which the subordinate goals are set up in an antagonistic relation to each other (task requires performing either "action 1" or "action 2", but not both), MW would characterized by a decrease in the antagonistic relation between the subordinate goals, meaning that activating "action 1" would not necessarily involve inhibiting "action 2" (Goschke, 2013; Hommel, 2015).

It would be helpful to compare stimulus-response tasks (e.g., SART), commonly used in experimental research, with a slightly more complex activity. Imagine that I am playing a friendly game of chess against Peter and that nobody else is observing our game. My goal in this situation is to win the game or practice/improve my game. Now imagine a second scenario, in which I play a game against Peter in order to impress Sally. The superordinate goal, winning-the-game, is not the same goal as winning-to-impress-Sally. We could describe the winning-to-impress goal as a "distraction" or as an object of MW. The simplistic (task-switching) approach would divide my engagement with the situation into two mutually exclusive states: (a) focused on winning the game and (b) focused on impressing Sally.

The style-based approach, on the other hand, considers the influence of concurrent goals on each other, and the possibility that new states might emerge as a result. If I am simply immersed in the game, driven to win the game, I might adopt a boring and cautious style of play that leads to victory. If I am "distracted" by the goal of impressing Sally, I might play a daring tactical combination that wins *and* is impressive. The cognitive flexibility entailed by MW can, therefore, result in disengagement from an activity (distraction from the game), switching to a different activity (imagining how good it would to win Sally's affection, albeit with the delusional assumption that winning a game of chess could have such an effect!), or modifying the first goal to accommodate the second goal (playing in a more daring and interesting way). The third outcome is possible in tasks that are open to modification. Experimental tasks, with pre-specified and usually nonnegotiable goals, cannot be modified in this way, which is why the task-switching approach appears as the only available way to theorize about MW.

The style-based approach to MW does not presuppose a difference between goals related to the current task and goals unrelated to the task. There is no inherent difference between the goals that are relevant to the current task and those that happen to be irrelevant to it. Similarly, the content of MW (e.g., self-related themes) is not inherently different from what we think about during task performance. One could perform self-related tasks as much as one can daydream about self-related themes. Thus, MW is not equated with disengagement from task. In a task-switching paradigm, where participants are required to regularly switch between Task 1 and Task 2, we would not regard switching from Task 1 to Task 2 as the participant's mind-wandering away from Task 1, even though MW and task-switching might

depend on the same underlying capacities (Baird et al., 2012; Lu et al., 2017). Similar to explorative behavior, MW could involve weakening of the current superordinate goal or the adoption of a more flexible relation to the goal (Gozli, 2019; Gozli & Dolcini, 2018). One might not begin mind-wandering only after one takes note of a task-unrelated goal; rather, one might take note of a task-unrelated goal because, and *after*, one has already entered a flexible mode of task performance.

Identifying MW with a style leads to asking whether some tasks, due to their structure, are more likely to encourage MW. Flexibility is a requirement in task-switching (Lu et al., 2017), when the stimuli we are presented with do not constitute a coherent whole (Smallwood et al., 2003), when the stimuli are ambiguous (Murray, 1938), or when we are asked to list as many different ways of categorizing an object as we can (Chrysikou, 2006; Hommel, 2015). By requiring flexibility, these tasks might promote MW *away* from tasks. In such cases, the task-switching approach cannot clearly distinguish between off-task (MW) and on-task (performance) states, because the structure of the task itself involves the same style of performance that is present during MW. By contrast, the style-based approach can identify MW independently of whether someone is in an off- or on-task state. That is because, to repeat, certain tasks (and tools) require MW.

Contrary to the perceptual-decoupling interpretation, MW can be associated with a more complex way of attending to stimuli. A brainstorming session or in a disorganized conversation between two improvisational actors is, in many ways, more complex than a conversation that stays on a narrow course. In an improvised conversation, or during an exploratory walk, each instance offers several different paths for further exploration. Similarly, in a metronome task, if I pay attention to the intensity of the sound of the metronome, and how far the metronome is from where I am sitting, rather than focusing on the rhythm, I am going from a superficial perception of the stimulus to a richer perception, although I would be covertly disengaging from the task and falling out of synchrony with the rhythm. In contrast to repetitive tasks that require sustained attention to particular features are the so-called divergent-thinking tasks, which require a scattered search for many categories that can be applied to a given stimulus (Guilford, 1967). We might also include among these the projective tasks that involve free-associating with reference to an ambiguous image (Murray, 1938). These tasks blur the boundary between performance and MW (Singer, 1981, p. 51).

You might think about counterexamples that do contradict the style-based approach. For example, being distracted by thoughts about an assignment during a lecture should presumably be categorized as MW, at least according to the task-switching approach, even when the thoughts are neither flexible nor explorative. What the task-switching approach labels as MW can include focused engagement, in thought or imagination, with something that is irrelevant to the nominal task. It is worth asking: What perspective demands the student's attention to always be devoted to the lecture? And can this perspective meaningfully label the inattention to the lecture "MW?" If we let go of that perspective (e.g., of the educational authority; norms of classroom behavior), do we have a psychological reason for labeling

the inattention "MW?" On the other hand, the style-based approach does not demand such an inattention to be called "MW."

Even though I believe inattention and MW should be distinguished as distinct categories, there might be a reason for identifying inattention during a lecture as MW. Importantly, this reasoning differs from the task-switching approach. The reason for calling such an inattention "MW" is because it involves simultaneous engagement with multiple distinct perspectives. In an important study of daydreaming, Morley (1998) identified three perspectives involved in his participants' reports: (1) the director and spectator of the daydream, (2) the participant in the daydream, and (3) the person left behind in reality. The three positions can vary in salience. A vivid daydream, (1) and (3) are in the margins of experience, while (2) comes to the foreground. Moreover, salience in (1) is associated with a feeling of control over the imagined world. The reason why daydreaming is an instance of MW is not merely because daydreaming is directed at an absent situation. Rather, it is because daydreaming involves multiple perspectives. These perspectives require flexibility both for maintaining them at the same time and for shifting emphasis among them. Thus, inattention during a lecture might be called MW, not because of what the student is paying attention to, but because of how the student is maintaining multiple perspectives at the same time and shifting her focus among those perspectives.

The style-based approach is consistent with some of the intuitive decisions made by experimental researchers. Recall the distinction between feeling hungry (not MW) and thinking of what one would like to eat for lunch (MW), during an experimental task (Antrobus et al., 1970). The distinction agrees with Morley's (1998) analyses, who identified daydreams of staging of a mood or desire (see also Freud, 1989/1907 and Žižek 1991). To become a daydream, the desire and its imagined fulfillment must be "staged." This approach can explain the intuitive appeal of the "perceptual decoupling" idea. To mentally stage a desire, one has to disengage from what is perceptually present, especially when what is perceptually present is unrelated to one's desire. Thus, we recognize the possibility of perceptual decoupling without seeing it as a necessary feature of daydreaming. The style-based approach also opens the possibility of examining how MW can evolve transform time (Dario & Tateo, 2019). People can achieve a more reflective and self-aware relation to their MW, for instance, by enacting scenarios in which a desire is conceived in concrete terms (Morley, 1998). Of course, the *possibility* of reflection and self-awareness does not guarantee that we always reach these states in relation to our daydreams. But even when it lacks reflective self-awareness, a daydream offers an opportunity for further explication and reflective awareness.

By providing a direct description of MW, the style-based approach can more easily recognize that MW does not have to represent a disrupted activity (Dario & Tateo, 2019). Neither does it have to accompany negative affect (Stawarczyk, 2018). If people believe that the object of their MW, including something they desire, is utterly unavailable, then they may experience a negative feeling. On the other hand, if they believe the desire is soon to be fulfilled, they may experience a positive feeling. Accordingly, we do not need two distinct types of MW that correspond to positive and negative affect. Likewise, we can argue that reflective and unreflective

daydreaming correspond not to two distinct types of phenomena, but to variations in relative dominance of different perspectives involved in some instances of MW (Morley, 1998). Reflective MW can be characterized by the dominance of the "spectator" perspective, whereas an unreflective MW can be characterized by the relative dominance of the "participant" perspective. Again, we do not immediately have to assume two distinct types of MW that correspond to reflective and unreflective states when we can attribute the differences to features of a multidimensional concept.

Throughout the chapter, I have emphasized how the tasks/methods for studying MW influence reasoning about MW and the possible conclusions that become available. Perceptual decoupling was an example of an idea that results from a bias built into the methods of research. Returning to the idea of *tools for MW*, let us consider the following task. Participants are sitting in front of a movie screen, on which a movie about dolphins is being shown. While their eyes are directed at the screen, they are instructed to completely ignore the movie and, instead, to imagine playing a game of golf. They are instructed to imagine the golf game in as much detail as possible. Successful performance in this task requires perceptual decoupling from the dolphin movie. We might even consider attention to the dolphins as MW in this context. In this example, we could describe the movie as a "distraction" or as a tool for mind-wandering. This tool could be used differently by different participants. One person might unreflectively become immersed in the movie, disengaging from the task. Another participant might deliberately imagine playing golf under water against a team of dolphins, in an attempt to combine the movie with the task requirement.

MW tools might include familiar objects and artifacts, such as a smartphone or a song, although they do not have to be familiar. An opaque piece of art or an unfamiliar piece of music can become entangled with our ongoing thoughts and feelings, taking us in directions we would not have taken without them. Characterizing MW in terms of perceptual decoupling, or in terms of attention to "internal" and private events, neglects instances where MW is enabled, triggered, and guided by perception of external events. In discussing his experience, Singer (1981) referred to his use of pen and paper for daydreams that had elaborate details (e.g., a series of baseball games). What if the daydreamer encounters the notes from a previous daydream? Will he be more likely to initiate another episode of daydreaming? With the increasing role of technology in our lives, it is worth considering in what ways a smartphone can become a tool for MW.

Considering the role and availability of technology might result in different styles of inquiry in MW research. For instance, we might ask whether students who do study near their smartphones have daydreams that differ in quality from students who study away from their smartphones. That could be because smartphones represent access to domains of experience that would be inaccessible without them. Rosen et al. (2013), who observed students studying for an exam, found that students spent, on average, 65% of a brief (15-min) study session on social media. Would it be reasonable to describe such distractions as MW? If daydreaming is the enactment of a desire, it stands to reason that certain tools might facilitate it. Social

networking sites might provide the tools for MW about one's social status, social comparison, and relationships. We might also be able to control MW with the help of technologies designed for regulation of our attention (see Mrazek et al. 2012).

Conclusion

Without a direct approach to MW, the task-switching approach is vulnerable to making distinctions that are ultimately unhelpful to understanding what MW. That is because task performance is taken as the point of reference, against which MW is identified. For instance, Wang et al. (2018) identified two statistically dissociable individual traits that could be described as MW. These two traits were described as "habitual positive-thinking" and "habitual distractibility." Similarly, Kane et al. (2017) identified two types of MW, associated with inside-the-lab tasks and outside-the-lab activities. The first category was correlated with trait Neuroticism, whereas the second was correlated with trait Openness. Although these studies are informative, they do not address the common features of MW. Rather than showing that MW is a useful construct, they suggest that it does not correspond to an organized category of phenomena.

The very possibility of MW, or the fact that certain phenomena have been called MW, entails that two or more competing goals can be simultaneously active. The goal of completing an experiment, for instance, can be concurrent with the goal of minimizing effort, guessing the purpose of the experiment, or planning the rest of the day. When faced with a difficult task, participants might covertly adopt an approximation of the task rules that (a) allows them to be efficient and (b) results in occasional errors. Likewise, to test how well an experiment is designed, a participant might commit errors intentionally and test whether the experiment will provide any feedback. MW further indicates that tasks can be treated in more or less flexible ways. Participants might switch between the original form of the task and their own approximation of the task while occasionally daydreaming or reflecting on their boredom. The task-switching approach regards MW in terms of focus (succeeding vs. failing to maintain focus on task). The style-based approach, in addition, can regard MW in terms of multitasking (succeeding vs. failing to maintain multiple tasks at once).

We began with the idea of tools for MW, which helped blur the boundary between, on one hand, the mind and mental processes and, on the other hand, the tools and tasks that enable or facilitate the mental processes. I applied the idea of tools to research methods in MW, arguing that the dominant methods of research have severely limited the concept of MW, representing it primarily as a type of task-switching. In contrast, to the task-switching approach, I developed a style-based approach, which views MW in terms of a flexible relation to goals. When our thinking is not overly constrained by the standardized experimental tasks, with fixed goals and simple rules of performance, we can identify cases in which a flexible relation to multiple goals can result in the emergence of new goals (cf. Gozli &

Dolcini, 2018; Tateo, 2020). In general, therefore, research would benefit from considering MW, not only as a failure that happens to research participants but also as a persistent phenomenon that could run through a field of research, guiding and limiting its scope. Finally, I hope to have shown how the two approaches to MW reflect different paths for future research, particularly in relation to tools that enable and facilitate MW in scientific and educational contexts.

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Chapter 7
Windows to the Mind: Neurophysiological Indicators of Mind Wandering Across Tasks

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Introduction

Imagine a classroom situation: some students seem to be listening attentively, whereas others appear to stare blankly into space or doodle away in their notebooks. This scenario illustrates the spectrum of mental states that students could experience during a learning situation, ranging from being strongly engaged with the lecture content to focusing on other things entirely, or not thinking at all. The shift in attention away from a task to self-generated, task-unrelated thoughts is also known as mind wandering and has been shown to influence learning in a mostly negative way (e.g., Randall et al., 2014). For instance, mind wandering during virtual lectures (Faber et al., 2020; Hutt et al., 2017) and face-to-face lectures (Wammes et al., 2016) is related to worse performance on a quiz. These adverse effects highlight the importance of establishing when, why, and how mind wandering arises to be able to potentially alleviate its negative effects on learning.

However, mind wandering is notoriously difficult to measure. There are several reasons for this. First, the measurement of mind wandering often relies on self-reporting, which is inherently subjective and prone to error, due to biases pertaining to the demand characteristics of an experiment or evaluation apprehension (e.g., the Hawthorne effect; Smallwood & Schooler, 2015). In addition, the act of self-reporting might have limited ecological validity and disrupt the natural flow of a

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task or process. Despite these downsides to self-reports, they do provide valuable insights into variations across tasks and people and open up the possibility to identify behavioral and neural correlates of mind wandering that could potentially be used as a more objective measure.

Second, it is unlikely that there is one set of behaviors and/or neural signatures of mind wandering that generalizes across all tasks and situations. For instance, zoning out during driving might manifest as a "tunnel vision" on the road ahead (He et al., 2011), whereas mind wandering during a boring vigilance task might cause a person to look away from a central point of fixation (Faber et al., 2020). The neurophysiological correlates of mind wandering might therefore depend on task affordances, such as what "normal," on-task behavior looks like and what kind of processing the task requires. These idiosyncrasies are important to take into consideration in the development of measures for identifying mind wandering in the classroom, which is a highly heterogeneous context.

In this chapter, we will provide an overview of subjective and objective measures of mind wandering, their applications, and their current limitations, and we will discuss implications for measuring mind wandering in educational contexts. We will argue that by triangulating subjective self-reports with indirect behavioral and neurophysiological measures, it is possible to arrive at more comprehensive measures of mind wandering.

Measuring Mind Wandering

Subjective Measures

Perhaps the most straightforward method for measuring mind wandering is to directly ask people about the content and unfolding of their thoughts. This can be accomplished through questionnaires, online self-reports, and offline self-reports. Questionnaires include measures that either tap into mind wandering as a trait (e.g., overall self-generated thought tendencies) or as a state (e.g., how much a person thinks they mind wandered in a specific situation). Trait-level measures, such as the Imaginal Process Inventory (IPI; Singer & Antrobus, 1972), the Mind Wandering-Deliberate and Mind Wandering-Spontaneous questionnaire (Seli et al., 2016), or the Mind Wandering Inventory (Gonçalves et al., 2020), capture stable self-generated thought tendencies. However, trait-level measures are not always reliable predictors of task-related behavior: a previous work has shown a discrepancy between mind wandering proneness scores (trait-level) and self-reported online mind wandering measures and eye gaze-based measures during reading (Faber et al., 2018a). It is possible that this lack of convergence is due to inaccurate self-appraisal or other biases. However, it could also reflect a meaningful distinction, such as a discrepancy between the experience of mind wandering during everyday life and during a cognitively demanding task, or a distinction between being able to

report a gist-level measure of mind wandering versus having awareness of and/or access to individual mind wandering thoughts (Dias da Silva et al., 2020).

There are several measures that aim to tap into state-level processes. Retrospective questionnaires typically are designed to have participants characterize the average content (Seibert & Ellis, 1991) or frequency (Matthews et al., 1999; Smallwood et al., 2004) of thought during a preceding period but are prone to memory-related errors or omissions (Ellamil et al., 2016). Online reports involve intermittently asking individuals about the contents of their thought in real time. These questions, referred to as probes, are used to track the contents of thought during resting state, during performance of an experiment, or in everyday life using smartphone applications, for example. An alternative to probing participants during a task is to ask individuals to report whenever they catch their minds wandering (Smallwood & Schooler, 2015). However, most individuals' ability to catch their mind in flight and to report on the mental processes and dynamics that give rise to thought content is generally considered to be poor (Ellamil et al., 2016). There are some individuals, however, such as experienced meditators, who have high levels of meta-awareness. These individuals are capable of catching their mind wandering episodes in flight with high temporal precision. Therefore, an alternative experience sampling approach to tapping into the dynamics of mind wandering is to collect self-reports from these individuals while they undergo a brain scan (e.g., fMRI), a method called neurophenomenology (Ellamil et al., 2016).

Online reports appear to be the best method to date. Moreover, they are less prone to memory and self-serving biases, which could influence both retrospective and trait-questionnaire reports. In addition, they can yield the richest data, as they enable a large number of distinctive thought reports that can reveal corresponding distinctive neural, physiological, and behavioral correlates. Nevertheless, experience sampling approaches alone cannot capture moment-to-moment fluctuations between states of mind wandering and focused attention. Therefore, it is important to triangulate different direct measures of mind wandering with indirect behavioral measures such as accuracy and neurophysiological measures across tasks (Smallwood & Schooler, 2015).

Objective Measures

As outlined above, the phenomenon of mind wandering has been studied extensively over the last decade. However, most studies suffer from inherent limitations imposed by their reliance on subjective measures of mind wandering.

These subjective self-reports are critically dependent on meta-awareness, which is the explicit awareness of the content of thought (Schooler et al., 2011; Smallwood & Schooler, 2006). To alleviate these issues, attempts have been made to measure mind wandering by triangulating self-reports, behavioral measures, and neurocognitive measures (e.g., Faber et al., 2018a; Mittner et al., 2014; Smallwood & Schooler, 2015).

Eye Tracking Findings

One particularly promising avenue is the use of eye movement to detect mind wandering: eye tracking is cheap, noninvasive, minimally intrusive, and scalable to naturalistic settings such as classrooms (Bixler & D'Mello, 2016). Eye movement recordings tap into what is known as the "eye-mind link" (Just & Carpenter, 1976), that is, that gaze reflects the deployment of cognitive resources to the external world. Accordingly, as reviewed below, studies have found that a number of gaze parameters are linked to mind wandering and are broadly thought to reflect the decoupling of attention from processing external stimuli that occur during mind wandering (Smallwood & Schooler, 2006). The first notion of studying eye movements to understand mind wandering stems from the 1960s when researchers found that eye movements and blinks were more frequent when participants were actively engaged in thinking or suppressing a daydream than when they were mind wandering (Antrobus et al., 1964). Subsequent studies have attempted to identify the eye movement correlates of mind wandering—mostly in the domain of reading—but findings have been mixed. Below, we will first discuss what normal reading behavior looks like, followed by a discussion of studies that have looked into how gaze behavior changes during mind wandering during reading and other tasks.

During attentive reading, eye movements typically follow a regular pattern (i.e., from word to word), and fixation durations—the period of time when gaze remains relatively still and new information is acquired—vary as a function of the length, frequency, and processing difficulty of the words in the text (Foulsham et al., 2013; Reichle et al., 2010), that is, more difficult words are associated with longer fixation durations on words, a pattern that is thought to reflect greater lexical and linguistic processing for that word. Moreover, roughly 10–15 percent of saccades—the period of time when the eyes are in motion—regress (backward eye movements) to previous words (Rayner et al., 2006) and become more frequent during difficult parts of the text where comprehension requires greater processing. Left-to-right saccades also typically become shorter, as measured by the angular distance of the saccade (saccade amplitude), within more difficult texts, so that each word is carefully fixated, processed, and understood (Rayner, 1998). Considered collectively, the gaze patterns observed during normal reading are thought to reflect systematically the real-time lexical and linguistic processing demands for the given text.

Studies investigating mind wandering during reading (i.e., mindless reading), however, have identified deviations in gaze patterns from focused reading, which, when considered collectively, suggest a decoupling between gaze and text features (D'Mello et al., 2013; Faber et al., 2018a; Loboda, 2014; Schad et al., 2012). As one illustrative example, Reichle et al. (2010) recorded eye movements as participants read an entire novel over the course of several days. Periodically, participants self-reported whether they were attentively reading or mind wandering in a given moment. Results showed that self-reported mind wandering was associated with longer fixation durations, with observable differences up to 120 s prior to the self-report. Furthermore, the variability in fixation durations associated with mindless

reading was unrelated to word length or frequency, unlike fixation durations during normal reading. This finding in particular suggests that the link between eye movements and linguistic characteristics (e.g., longer fixation on longer, low-frequency words) breaks down during mindless reading.

Subsequent studies have focused on establishing the relationship between mindless reading and fixation parameters, such as the number of fixations, their duration, and dispersion (Bixler et al., 2015; Bixler & D'Mello, 2014; Faber et al., 2018a; Frank et al., 2015; Uzzaman & Joordens, 2011), but results are mixed in terms of direction and significance of the observed effects (e.g., Foulsham et al., 2013; Steindorf & Rummel, 2020). Moreover, there are also inconsistent findings regarding other gaze parameters, such as saccades. For instance, mindless reading has been associated with changes in left-to-right reading behavior, with some studies showing smaller (Bixler & D'Mello, 2014), longer (Bixler et al., 2015), and fewer saccades (Faber et al., 2018a) during mindless reading and others showing the opposite effects (Foulsham et al., 2013). Some studies indicate that mindless reading is also associated with fewer regressions (Foulsham et al., 2013; Reichle et al., 2010; Uzzaman & Joordens, 2011), but others have shown that this effect interacts with age (Frank et al., 2015). The collective conclusion from these investigations suggests that eye movements do change during mindless reading—which likely reflects a change in the cognitive processes that support comprehensive reading, such as lexical and linguistic processing—but the direct relationship between eye movements and mind wandering during reading remains underspecified. Moreover, it remains unclear what gaze behaviors are reflective of mind wandering more broadly—such as contexts with limited visual information (e.g., listening to an audio book) or stimuli that strongly direct visual attention (e.g., watching narrative films; Loschky et al., 2015)—which would provide further insight into how visual and cognitive processes operate under varying states of attention.

Indeed, relatively few studies have explored the gaze correlates of mind wandering in contexts other than reading and those that did display some heterogeneity in their observed associations. To illustrate, during narrative film comprehension, mind wandering is accompanied by a decrease in smooth pursuit of salient objects (Mills et al., 2016). When watching a lecture on the other hand, gaze parameters that capitalize on these local relationships (e.g., pursuit of salient objects) did not contribute much to the identification of mind wandering over and above the characteristics of fixations and saccades (Hutt et al., 2017). However, recent work has shown that viewers fixate more on the lecturer when mind wandering, and fixations in the lecture slides become longer and less dispersed (Zhang et al., 2020). For learners interacting with an intelligent tutoring system, mind wandering could be predicted from context-independent (global) gaze parameters such as fewer fixations and saccades, more dispersed fixations, and longer and slower saccades (Hutt et al., 2016, 2017). Likewise, when exploring a visual scene for a later memory task, fewer, longer, and more dispersed fixations were associated with mind wandering (Krasich et al., 2018). In the context of driving, however, He et al. (2011) found that participants made fewer horizontal saccades when mind wandering, which suggests smaller fixation dispersion and a reduced propensity to broadly scan the road.

Although there is some consistency across these findings, collectively they suggest that task affordances might determine which gaze parameters are predictive of mind wandering in each context.

To address this issue, recent work has systematically investigated the gaze correlates of mind wandering across tasks (Faber et al., 2020). Specifically, seven brief tasks were used that vary in terms of spatial allocation demands, visual processing demands, and discourse processing demands. The tasks consisted of a sustained attention to response task (SART), listening to an audio book, reading a narrative story, studying a visual scene, studying an illustrated text, watching a recorded lecture, and watching a narrative film. Mind wandering during tasks that require extensive sampling of the visual field, such as reading, studying a scene, and studying a diagram, was associated with a decrease in fixations and, in some cases, with longer or more dispersed fixations. Taken together, these findings suggest that visual sampling becomes sparser across the board, although the specific gaze correlates might vary slightly across tasks. This sparsity supports the idea that self-generated thoughts are prioritized over the processing of external information during mind wandering, suggesting that a decrease in eye movements represents a global dampening in visual information processing. As discussed below, this account is supported by previous findings from neuroimaging research (e.g., Baird et al., 2014; Barron et al., 2011; Kam et al., 2011; Smallwood et al., 2008c).

In contrast, for tasks in which participants normally focus on a central fixation point, such as a SART, listening to an audio book, and watching a lecture, mind wandering was associated with shorter fixations, more dispersed fixations, and larger saccades, suggesting more exploratory eye movement behavior. However, these relationships were found to be less generalizable, suggesting that eye movement behaviors might not be robust behavioral signatures of mind wandering in these contexts. In addition, these fixation parameters were found to not be predictive of mind wandering during narrative film watching. The processing demands of narrative films differ from those of other stimulus contexts in that narrative films are heavily edited to guide attention (see Zacks, 2015) and, therefore, gaze (Loschky et al., 2015) and mind wandering (Faber et al., 2018b), such that mind wandering is less likely to occur during periods in which there are more changes in the depicted events (e.g., change in scene, shift in time). Eye movements might be more strongly predicted by whether the eyes follow the salient characters and/or objects rather than by a global dampening in visual processing (Mills et al., 2016).

The idea that attentional decoupling during mind wandering might increase the likelihood that the eyes also "wander away" has previously been phrased in terms of an exploration-exploitation tradeoff (Jepma & Nieuwenhuis, 2011). Previous work has shown that mind wandering during a stop-signal paradigm (which is similar to a SART in terms of visual presentation) is related to an increase in exploratory behavior (Mittner et al., 2014). This behavior is thought to be modulated by the locus coeruleus-norepinephrine (LC-NE) system and has previously been linked to changes in pupil diameter (Jepma & Nieuwenhuis, 2011) that are thought to index cognitive load (Granholm et al., 1996). A number of studies have shown (often conflicting) associations between mind wandering and pupil size and response using

tasks with a central fixation point (Franklin et al., 2013; Grandchamp et al., 2014; Konishi et al., 2017; Mittner et al., 2014; Unsworth & Robison, 2016). However, pupillometry is not necessarily suitable for all tasks: for tasks that require extensive sampling of the visual field, each fixation would be accompanied by a difference in luminance and other low-level visual properties that can impact pupil diameter independently from the cognitive state of the observer. Moreover, in free viewing tasks, measurements of pupil diameter can be confounded due to changes in eye orientation when looking at the edges of the screen (Hayes & Petrov, 2016). Still, the (albeit not entirely understood) relationship between mind wandering and pupil diameter supports the idea that mind wandering is associated with an exploration-exploitation tradeoff in tasks that afford fixations focused on a small area of the visual field.

Taken together, the findings reviewed above suggest that there are patterns of eye movement deviations that are predictive of mind wandering, but it is likely that idiosyncrasies across tasks hinder the identification of one set of eye movement behaviors that generalize across all potential situations.

EEG Findings

Studies using electroencephalography (EEG) are becoming increasingly popular in the study of mind wandering across a variety of fields, ranging from psychology to brain computer interface research. In comparison to eye tracking, EEG measurements are more expensive, more intrusive, and less scalable[1] to naturalistic settings such as classrooms (D'Mello et al., 2016). EEG is useful for measuring brain activity time-locked to stimuli under controlled situations but is difficult to interpret in more complex tasks that rely on naturalistic variation, such as reading a book or watching a movie, as the design of an EEG experiment critically relies on a comparison between conditions and/or against a baseline. In addition, EEG has a poor spatial resolution, as it is only capable of measuring electrical activity at the surface of the cortex, making it difficult to localize signals which originate deeper in the brain (Sturzbecher & de Araujo, 2012). However, EEG has very high temporal precision, capable of recording from 250 to over 2000 samples of electrical brain activity per second. As such, it provides valuable insight into the evolution of cognitive processes during mind wandering across time. Moreover, when triangulated with findings from other modalities, it helps to paint a fuller picture of the dynamics associated with mind wandering. Results from these studies contribute to increasing our understanding of the cognitive processes underlying mind wandering states. Similar to the pattern found in eye tracking studies, findings do not always converge across EEG studies. In what follows, we give an overview of brain signatures

[1] There are cheaper, more scalable EEG sensors, but their signal quality tends to be inferior (Jeunet et al., 2019) and often unreliable.

typical of focused attention toward a task, followed by an overview of studies that have looked into how EEG measures change during mind wandering. We first discuss findings related to event-related potentials, and we subsequently focus on oscillatory findings. We then attempt to reconcile seemingly disparate findings by proposing that there is no "one-size-fits-all" neural signature of mind wandering but that, instead, this signature varies according to the type of task being performed as well as individual differences.

Neural activity has been often investigated during sustained attention tasks, such as under different variations of the oddball task, in which participants are requested to respond to rare stimuli, or of the sustained attention to response task (SART), where they withhold responses to rare stimuli. These are generally monotonous tasks which require participants to respond to stimuli over extended periods of time. Focused, on-task behavior during these tasks is accompanied by early event-related potentials (ERPs) elicited by early attention control mechanisms in occipital regions of the brain (Hillyard et al., 1998). The P100, which occurs within approximately 100 milliseconds of stimulus onset is evoked in response to visual stimuli. The N100, which occurs in this same time frame, is elicited by auditory stimuli. These early components are thought to be related to alerting attentional mechanisms (Hillyard et al., 1998). In addition, to early sensory responses, focused behavior is also associated with a later component, namely, the P300 ERP, in parietal and occipital regions of the brain (Polich, 2007). This response is presumed to be driven by the activation of orienting networks and working memory updating and is indicative of cortical processing of stimuli or events (Dehaene & Changeux, 2011; Mashour et al., 2020).

Moreover, patterns of oscillatory activities have also been investigated in relation to focused attention. Oscillatory activity in the beta (13–30 Hz) frequency band has been associated with task-related, visual attention (Gola et al., 2013; Laufs et al., 2006). Activity in the gamma (30–100 Hz) frequency band has been associated with executive attention, working memory, and long-term memory activation (Jensen et al., 2007). Theta (4–7 Hz) and alpha (8–13 Hz) frequencies have been associated with top-down processes and working memory (Baird et al., 2014; Sauseng et al., 2005). In addition, a reduction in alpha band power has been commonly observed when attention is oriented toward an external visual task (Klimesch, 2012; Mann et al., 1996; Pfurtscheller et al., 1996).

Studies investigating mind wandering during sustained attention tasks report changes in both ERP responses and in oscillatory patterns characteristic of focused attention. With regard to ERP responses, there appears to be an attenuation in both early and later components during mind wandering. Several studies consistently describe an attenuation of the P300, indicating a decoupling of top-down attentional processes (e.g., Barron et al., 2011; Kam et al., 2011; Smallwood et al., 2008a). Other studies also report an attenuation in the P100 and N100 components (Baird et al., 2014; Kam et al., 2011), indicative of sensory-motor decoupling in the visual and auditory domains, respectively. The fact that some studies have found differences in early sensory components and others have not can be explained by differences in the types of tasks being performed. Studies that fail to find changes in

sensory ERPs tend to present visual stimuli at fixation (i.e., standard versions of the SART). However, studies in which responses to parafoveal stimuli have been measured report attenuations in both the P100 and P300 (Kam et al., 2011) during mind wandering. Moreover, an attenuation in the N100 component has been found in tasks requiring participants to respond to auditory stimuli (Braboszcz & Delorme, 2011; Kam et al., 2011).

With regard to oscillatory activity, variations in alpha rhythm play an important part in both perception and attention (Klimesch, 2012). Increases in alpha have been associated with internal processing (Benedek et al., 2014), supporting the notion of a decoupling from the environment during mind wandering. In a rapid serial visual presentation (RSVP) task, pre-stimulus alpha was found to increase over parieto-occipital sites (Macdonald et al., 2011). Similarly, Compton et al. (2019)[2] found increases in alpha power measured up to 10 seconds prior to reports of mind wandering over frontal, central, parietal, and occipital scalp areas during a Stroop Task – with higher alpha toward posterior sections of the scalp. Under a more ecological experiment consisting of a driving simulation, Baldwin et al. (2017) also found alpha to increase in posterior scalp areas.

In contrast, Baird et al. (2014) found a reduction in event-related alpha (9–11 Hz) and beta (15–30 Hz) spectral power over frontal,[3] central, and parietal[4] scalp regions after stimulus onset during an undemanding vigilance task.[5] Moreover, they found a decrease in theta band (4–7 Hz) cortical phase-locking over parietal regions of the brain. Lutz et al. (2008) propose that increase in phase-locking is related to a reduced tendency to engage in task-unrelated thoughts (see Cahn et al., 2013).

During a breath counting task with a passive auditory protocol (which participants performed with their eyes closed), Braboszcz and Delorme (2011) found decreases in alpha and beta activity in occipital and fronto-lateral areas, respectively, prior to self-caught episodes of mind wandering. Moreover, they found increases in theta band oscillations over all scalp regions to be associated with mind wandering, which were particularly more pronounced over occipital and parietal areas. Similarly, van Son et al. (2019) found a greater theta-beta ratio in frontal scalp areas during mind wandering. Increased theta oscillations are typically associated with decreases in sustained task-related attention and during transitional stages from wakefulness to sleep (Braboszcz & Delorme, 2011; Klimesch, 1999), while a higher theta-beta ratio has been often related to lower attentional control (van Son et al., 2019).

While some studies indicate that increases in alpha (Baldwin et al., 2017; Benedek et al., 2014; Compton et al., 2019; Macdonald et al., 2011)—particularly over parietal and occipital scalp areas—are a distinct neural signature of mind

[2] Interestingly, greater differences in alpha power between attentional states were associated with better performance on the Stroop Task.

[3] Spectral power reductions over frontal scalp areas were found for both the alpha and beta bands.

[4] There were spectral power reductions for only the beta band in central and parietal sites.

[5] Participants completed a 0-back vigilance task, in which they were required to respond to infrequent targets.

wandering, others propose increases in theta and decreases in alpha instead (Baird et al., 2014; Braboszcz & Delorme, 2011). What we notice is that alpha seems to increase during mind wandering in tasks requiring sustained visual attention to the external environment. As such, it seems to be more indicative of a visual sensory-motor decoupling during mind wandering. During tasks which do not require visual attention, but attention to auditory stimuli (or internal states) instead, alpha increase seems to be actually related to increased processing (Cartocci et al., 2018; Wisniewski et al., 2017), while decreased alpha has been shown to be related to low levels of vigilance (Braboszcz & Delorme, 2011). Meanwhile theta seems to increase prior to mind wandering reports in situations which do not require attentiveness to external stimuli, that is, in tasks with low to no visual perceptual acuity. For example, in the breath counting task in Braboszcz and Delorme's (2011) study, performance did not require any responses to external stimuli but rather attentiveness to internal states. As such, it is possible that theta increases reflected the ability to be aware and attentive to one's own internal state, which was essential for catching the mind wandering.

Recent work has shown that theta band connectivity (i.e., the frequency-locked synchrony between two brain areas or networks) between the default mode network (DMN) and a subsystem of the frontoparietal control network that is associated with abstract thinking, emotional processing, episodic and prospective memory, and mental simulation of events (Dixon et al., 2018) increases when attention is directed inward (Kam et al., 2019). This observation is in line with a wealth of studies that have previously shown that DMN activity is linked to cognitive processes that require internally focused attention[6] (vs external attention), including mind wandering.[7] Simultaneous EEG and fMRI have shown associations between theta activity and the BOLD response in the DMN during resting state (i.e., a state without a task), suggesting that, indeed, theta activity might be an EEG marker of mind wandering (Scheeringa et al., 2008). Paralleling these findings, Kirschner et al. (2012) found increased connectivity also in the alpha, beta, and gamma frequency bands across regions of the DMN preceding mind wandering reports, suggesting convergence across different neuroimaging markers.

Evidence from resting state (i.e., task-free) and task fMRI has also revealed that individual variations in mind wandering propensity can be linked to variations in static DMN functional connectivity, whereas ongoing mind wandering episodes are reflected in time-varying DMN functional connectivity (Kucyi & Davis, 2014), suggesting that both trait and state levels of mind wandering can be measured using fMRI. This opens up the opportunity to study mind wandering and its unfolding during tasks that are difficult to study using EEG, such as reading or watching a film, due to the fact that the analysis of EEG data critically relies on a comparison between different conditions or against a baseline. Although the field of detecting mind wandering using fMRI is still in its infancy, recent work has shown that it is

[6] See Buckner and DiNicola (2019) for a recent overview.

[7] See, e.g., Fox et al. (2015) for an overview.

indeed possible to use multivariate pattern classification of fMRI data to distinguish between distinct experiential axes of mind wandering (Wang et al., 2018). It is likely that these methodological advances will enable more in-depth characterizations of the neural signatures of mind wandering. Despite the fact that fMRI might never be scalable to classroom situations, these insights are nevertheless important for understanding the cognitive processes that underlie the neurophysiological features that we can measure using other sensing technologies during learning. In particular, they can shed light on the question whether the observed patterns of task (−cluster)-specific neurophysiological features (e.g., eye movements, motor movements, ERP signals) are associated with distinct up- and down-regulations of brain networks that vary across those tasks/clusters in a principled manner and whether there are differences and/or similarities between tasks that are not reflected in other sensing modalities.

Although the focus of this chapter is on neurophysiological features, there are also behavioral indices that are associated with mind wandering. Previous work has, for instance, used facial features, posture, response times, and mouse tracking to distinguish between on- and off-task states. Several facial features, such as lowering of brows, raising cheeks, wrinkling nose, tightening lips, dimples, and dropping of the jaw, have been associated with mind wandering across tasks contexts (e.g., reading an expository text and watching a narrative film; Stewart et al., 2017). In addition, posture changes during mind wandering such that the face drops and moves closer to the screen (Stewart et al., 2017). Mouse movements (Dias da Silva & Postma, 2020) and reaction times (Bastian & Sackur, 2013; Smallwood, McSpadden, Luus, & Schooler, 2008b) become slower and more variable, although results vary across tasks. A more detailed report of these bodily features and their relationship to mind wandering can be found in (Dias da Silva et al., 2022) this book.

In the context of education, a triangulation of neurophysiological and behavioral (or bodily) features with self-reports can be helpful for identifying indirect measures of mind wandering that are generalizable across different learning contexts. If successful, this could lead to the development of "attention-aware" learning tools, such as software that helps the learner get back on track when they go off-task (D'Mello et al., 2016). For these strategies to be successful, it is necessary to identify which constellations of features are most likely to signal mind wandering during a variety of learning activities. In the remainder of this chapter, we will discuss machine learning studies that have attempted to predict mind wandering from neurophysiological and bodily features in the context of learning. In particular, we focus on how successful these methods are at detecting mind wandering in the context of an intelligent tutoring system—a computerized system that encompasses several learning activities including, e.g., reading, exercises, lectures, and animations—in the lab and in the classroom.

Mind Wandering Detection

In the past decade, applied research on mind wandering in the context of intelligent tutoring systems has been greatly facilitated by the advances in predictive modeling by means of machine learning. The main advantage of using data-driven techniques for mind wandering detection over traditional behavioral statistics is that the machine learning models are evaluated on the basis of their fit on unseen data, thereby preventing overfitting and the resulting lack of generalizability. The general goal of these approaches is to use detectable behavioral and psychophysiological cues, such as upper body movement (Stewart et al., 2017) including head pose (Bosch & D'Mello, 2019), facial features (Stewart et al., 2017), gaze patterns (Bixler & D'Mello, 2016; Blanchard et al., 2014; Brishtel et al., 2020; Faber et al., 2018a; Hutt et al., 2016, 2017; Zhao et al., 2017), electrodermal features (Brishtel et al., 2020), EEG (Hosseini & Guo, 2019; Jin et al., 2019), and heart rate changes (Pham & Wang, 2015) to predict upcoming episodes of mind wandering during a learning task. The negative impact of zoning out of the task could then be potentially alleviated by a reactive intervention or an alert, e.g., a sound or a visual stimulus, possibly representing detected levels of attention in real time (Mills et al., 2020). The alerting mechanism would draw the learner's attention back to the task at hand or would provide more engaging and relevant input. Next to that, a time-referenced analysis of the mind wandering data can be used post hoc to improve the educational tool itself, as in the case of the AttentiveLearner (Pham & Wang, 2015).

The most frequently used algorithms for predictive modeling of mind wandering by means of supervised learning include different kinds of logistic regression (Bixler & D'Mello, 2014; Hutt et al., 2016; Pham & Wang, 2015; Stewart et al., 2017; Zhao et al., 2017), random forests (Bixler & D'Mello, 2014; Brishtel et al., 2020; Hutt et al., 2016; Stewart et al., 2017), and support vector machines (Bixler & D'Mello, 2014; Bosch & D'Mello, 2019; Hosseini & Guo, 2019; Hutt et al., 2016; Jin et al., 2019, 2020; Pham & Wang, 2015; Zhao et al., 2017). Given that episodes of reported mind wandering tend to occur less frequently than on-task instances, the datasets on which the algorithms applied are often first preprocessed by class balancing techniques such as SMOTE (Synthetic Minority Over-sampling Technique) (Stewart et al., 2017). The technique, applied on the training set, oversamples the minority class, i.e., it synthesizes data points in the mind wandering class based on the values of available instances in the same class. The classifiers are typically trained and evaluated by means of the leave-one-participant-out or leave-several-participants-out cross-validation method (i.e., the data from a single user or multiple users are only included in the training set or in the test set, but not in both) to ensure that they are robust enough to perform independently of the user. The reported performance of the best classifiers is currently around 70% of accuracy for the user independent models with binary classification using machine learning models (Bixler & D'Mello, 2014; Pham & Wang, 2015). In addition to the standard performance metrics, some studies report the predictive validity of the model by

correlating the predicted (rather than actual) rates of mind wandering to learner performance (Bixler & D'Mello, 2014). An issue reported in several studies concerns the prevalence of false positives (recall greater than precision). As noted by Stewart et al. (2017), this is relevant for the implementation of the mind wandering algorithms in real-world applications, since an overuse of alerts and interventions might have a demotivating effect on the learner.

Most recently, several studies on mind wandering detection make use of the deep learning architectures such as convolutional neural nets (CNNs) and feedforward deep neural networks (DNNs). The performance of deep learning models, which are increasingly being used to analyze EEG signals, appears to exceed that of traditional machine learners for brain activity measures. For example, Hosseini and Guo (2019) reported an accuracy of 91.78% using a channel-wise deep CNN model. An additional advantage of the approach was that no feature extraction was necessary in the preprocessing stage. However, the study employed a dataset collected from only two participants; it thus remains to be seen to what extent the resulting model is applicable for other users. Next to EEG data, the deep learning approach was also tried out on in combination with automatic computer vision methods. Using two larger datasets of participants with data collected in a lab setting and a classroom setting, Bosch and D'Mello (2019) tested a DNN model for combination of features extracted from the upper body movement and facial expressions. Based on the F1 and AUC metrics, their DNN classifiers were able to perform somewhat above chance level but worse than a support vector machine (SVM) classifier, possibly due to the dataset size. Since human observer performance on the same dataset was rather poor, the modest performance of the two types of classifiers in general was likely due to the difficulty of the task suggesting that observable high-level features such as facial action units and upper body movement may not be the most reliable indicators of mind wandering episodes.

In an attempt to classify mind wandering episodes from EEG measures in more naturalistic settings, Conrad (2008) implemented various machine learning classifiers while students attended an online lecture. While watching a 50 minute lecture, participants were asked to click on a button whenever they caught themselves mind wandering. A linear discriminant analysis revealed that mind wandering could be distinguished from on-task states with an accuracy of 74% using both ERPs and frequency band oscillations. In addition, Dhindsa et al. (2019) recorded EEG activity from participants during a live lecture and intermittently asked participants whether they were mind wandering. Nonlinear SVMs were able to classify mind wandering episodes in individuals based on EEG features derived through data-driven feature learning (common spatial patterns) with accuracies over 80%. In addition to lecture settings, Hutt, Mills, White, Donnelly, and D'Mello et al. (2016) implemented a mind wandering detector which classified student's mind wandering episodes during interaction with an intelligent tutoring system from gaze features considerably above chance levels.

Conclusion

In recent years, research has aimed to triangulate subject self-reports with indirect behavioral and neurophysiological measures to provide a more comprehensive measure of mind wandering. In this chapter, we show that the main challenge for detecting mind wandering from neurophysiological features across tasks lies in the fact that groups of tasks appear to vary in terms of the clusters of features predictive of mind wandering. As we have shown, this is the case for eye movements, where there are clear discrepancies between tasks with different visual affordances and smaller deviations across tasks that vary in other task demands. As with eye movements, changes in frequencies of neural activity as measured with EEG vary across tasks, with specific task demands being related to whether activity is higher or lower for a specific frequency band. EEG has mainly been applied in the context of visual attention tasks, such as SART and other vigilance tasks. Although recent work has extended into domains that are more relevant for education, such as (online) lectures, relatively little is known about how brain activity changes during mind wandering in learning contexts. However, the success rates of several machine learning attempts suggest that EEG signals—potentially in combination with other measures such as eye movements or bodily behaviors—as mind wandering correlates might be one of the most promising ways forward in terms of measuring mind wandering from neurophysiological data.

However, there are still other challenges that need to be addressed. An important issue is scalability. Currently, EEG is not scalable due to it being expensive and intrusive, and cheaper EEG sensors tend to have inferior signal quality. Eye tracking might be a better option since they are relatively cheap and unintrusive, and with the development of better webcams and better analytical strategies for the detection of eye movement signal from video data, eye tracking might in the future be possible on a laptop, phone, or tablet without any additional hardware. Although neurophysiological measures—in particular EEG—might be good at distinguishing between mind wandering states at an individual level in both lab and classroom settings, patterns diverge across individuals. This might in part explain the discrepancies in findings that are observed across studies, in addition to or in interaction with task demands. As such, we propose that the availability of different deep learning architectures in combination with data collected from multiple participants across different channels including eye tracking, EEG, and fMRI may provide solutions to some of these challenges.FundingThis work was supported by the Netherlands Organization for Scientific Research Veni Grant No. VI.Veni.191G.001 (to MF).

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Chapter 8
Noninvasive Brain Stimulation for the Modulation of Mind Wandering

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Introduction

As individuals throughout the course of any given day, we will spend almost half our time with our attention being diverted from the tasks that we engage in. This pervasive spontaneous process, commonly known as mind wandering or daydreaming, is notoriously difficult to control, often requiring the individual to recognize that they themselves are distracted by thoughts and feelings that are unrelated to the external environment or present task (for a review see Smallwood & Schooler, 2015). These lapses of attention or awareness often become frustrating when we are required to maintain our focus for a prolonged period of time, for example, within a classroom setting. When our attention becomes decoupled from the external environment, i.e., the learning environment, then integrating information successfully becomes increasingly difficult and poses a hindrance to the learning process itself.

Here, we aim to discuss the role of noninvasive brain stimulation in modulating mind wandering and meta-awareness, i.e., the awareness of thoughts having drifted away. The ability to safely and reversibly influence mind wandering, and therefore states of inattentiveness and distraction, would offer many useful applications – the ability to remain attentive to a learning task being just one of them (Smallwood et al., 2007). A short introduction to the wide variety of brain stimulation techniques is included. We review the few studies that examine the impact of transcranial direct current stimulation on mind wandering and discuss the contradictory outcomes which indicate that further investigation into the application of this type of

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neuromodulatory stimulation is indeed warranted. Furthermore, we briefly touch on the potential role for noninvasive brain stimulation as a tool for the learning environment and also highlight a novel brain stimulation technique, auditory beat stimulation, that may offer advantages over conventional neuromodulatory methods.

Mind Wandering Is a Spontaneous Cognitive Process

Mind wandering is a term used to describe a wide variety of thought processes, including task-unrelated thoughts (TUTS), daydreaming, unintentional thought, and stimulus-independent thought (Schooler et al., 2011; Seli et al., 2016; Shrimpton et al., 2017). Even though it is often hard to describe, this pervasive and ubiquitous mental phenomenon affects almost every individual on a daily basis, comprising of almost 20–50% of our waking hours (Killingsworth & Gilbert, 2010; Seli et al., 2018). Defined as a "shift of attention away from an ongoing task (the so-called task at hand) to thoughts and feelings un-associated with task performance" (for a review see Smallwood & Schooler, 2015), it can exert both positive and negative effects on mood states (Killingsworth & Gilbert, 2010), and in exacerbated cases lead to goal neglect (McVay & Kane, 2009). The mechanism understood to underlie mind wandering reflects the cyclic activity of two important core processes. The first process is the detachment of attention from external perception (perceptual decoupling). The second process involves the capacity to capture explicit knowledge of the current contents of consciousness, specifically of wandering thoughts (meta-awareness) (Schooler et al., 2011). Meta-awareness of mind wandering increases the ability to re-focus on the task at hand.

Further to gaining an understanding of the complex interplay of processes that underlie mind wandering, the need to identify the neural correlates of mind wandering and meta-awareness grows. Once this has been achieved, finding target brain regions and states for the modulation of mind wandering becomes much less complicated.

Over the last decade, studies investigating mind wandering have identified brain regions typically comprising the default mode network (Andrews-Hanna et al., 2014) and executive control network (Christoff et al., 2009). A meta-analysis of neuroimaging studies examining mind wandering identified a number of regions within the default mode network, including the medial prefrontal cortex, posterior cingulate cortex, medial temporal lobe, and the hippocampus (Fox et al., 2015). The frontoparietal areas comprising the executive control network, including the dorsolateral prefrontal cortex (DLPFC) and inferior parietal lobule (IPL), are also understood to be involved in mind wandering and spontaneous thought (Fox et al., 2015).

Findings from a recent fMRI study investigating the cortical areas associated with the generation of spontaneous thoughts indicate that the hippocampus is the primary region which is activated before spontaneous thoughts arose. The regions of the default mode network and executive control network were only subsequently activated (Ellamil et al., 2016). This study is one of a few that suggest an emerging

role of the hippocampus in mind wandering (Andrews-Hanna et al., 2010). In a review addressing the dynamics of mind wandering, Christoff et al. (2016) suggest that the hippocampus may act as a kind of hub, whereby hippocampal-neocortical and neocortical-neocortical connections are reactivated prior to and during the generation of spontaneous thoughts (Christoff et al., 2016). New evidence from a study examining mind wandering in patients with bilateral hippocampal damage also indicates a role of the hippocampus in mind wandering, but rather for the contents of mind wandering and not for the propensity to mind wander (McCormick et al., 2018).

So far, the cortical regions involved in mind wandering have been identified using data from neuroimaging studies. Applying noninvasive brain stimulation may allow us to gain a deeper understanding of the causal role of these cortical regions in spontaneous cognitive processes.

The Role of Mind Wandering in Educational Contexts

While everyday occurrences of mind wandering may be simply distracting, but may not cause major inconveniences, attentional lapses in an educational environment can result in the failure to retain new information necessary for successful learning. Smallwood and Schooler (2006) state that "mind wandering represents a breakdown in the normal coupling between the internal and external environments" (Smallwood & Schooler, 2006). In that, when we are prone to mind wander, our focus of attention and awareness shifts away from the task at hand and does not encode elements of our external environment in a meaningful way. This underlines the need to prevent the occurrence of frequent episodes of mind wandering while learning, whether in a classroom setting or through online means.

In fact, the detrimental impact of mind wandering and related attentional failures on learning and education has been of concern for many years (Brown, 1927; Johnstone & Percival, 1976; Lloyd, 1968). Several approaches have been adopted to estimate the level of mind wandering that students engage in, and that ultimately exerts a significant impact on the retention of information. An early study investigating outward signs of mind wandering (e.g., gaze diversion, shifting of body position), reported that these physical signs of breaks in attention occur quite soon into a study period (10–18 minutes, after start), which increase in frequency toward the end of a lecture (every 3–4 minutes) (Johnstone & Percival, 1976). Other physical signals may also relate to mind wandering. A 2010 study examining the association between blinking and mind wandering during a reading task revealed that blinking often preceded moments of inattention (Smilek et al., 2010). This pattern of increasing frequency in attentional diversion, either intentional or unintentional, has been also observed in other studies using different approaches. For example, recent studies using experience sampling probes to directly access mind wandering while learning reveal that the most common attentional failures occurred while attending classes or lectures compared to carrying out everyday tasks (e.g., cooking or

driving) or even while holding a conversation (Kane et al., 2007; Unsworth et al., 2012). A study by Unsworth et al. (2012) estimated that up to 76% of self-reported lapses in concentration and attention occurred either in the classroom or while studying in a classroom environment (Unsworth et al., 2012). A similar study by McVay et al. (2009) looked at episodes of mind wandering in the everyday lives of college students. Although students reported that they engaged in mind wandering on approximately only 30% of the experience sampling probes throughout the period in which they were measured, the frequency of mind wandering increased when students at the same time reported being tired or anxious or when the task that they were undertaking was stressful or boring (McVay et al., 2009).

Another avenue of research is to investigate techniques that mitigate the impact of mind wandering on students' attentiveness. Although educational guidelines encourage the use of tasks such as short quizzes, group work, or live demonstrations to re-focus the attention of students (Middendorf & Kalish, 1996), very little research has been performed to help establish the efficacy of these methods. For example, Bunce et al. (2010) investigated the impact of these kinds of pedagogical practices on attention during chemistry lectures. The authors reported that after students had participated in the quizzes and observed the live demonstrations, bouts of mind wandering and lapses in attention decreased, and students were better able to retain information about the content of the lecture (Bunce et al., 2010).

Noninvasive Brain Stimulation Methods

Transcranial Noninvasive Brain Stimulation Methods

Over the last two decades, many forms of noninvasive brain stimulation (NIBS) have been developed. The most common can be divided into two main groups, either magnetic or electrical. The most frequently applied for both research and therapeutic purposes are transcranial magnetic stimulation (TMS), transcranial direct current stimulation (tDCS), and transcranial alternating current stimulation (tACS) (for a review, see Huang et al., 2017). The ease of application and reversible after-effects make these techniques an accessible and safe means of altering cortical excitability. These tools have different modes of action; TMS consists of high-intensity magnetic pulses created by passing current through a magnetic coil (Hallett, 2007). The magnetic pulses cause electric fields exciting or inhibiting a small volume of cortex under the stimulation coil. Such a technique is useful for cortical mapping and focal stimulation and has been used extensively as an adjunct treatment for depression (Chung et al., 2015) and some psychiatric disorders (Tremblay et al., 2019). Pulse train, frequency, and intensity determine the efficacy of TMS applications.

TDCS and tACS, however, are applied by placing two or more electrodes on the surface of the scalp, allowing current to flow between them and stimulating the

brain underneath (Lefaucheur et al., 2017). TDCS is dependent upon directional current flow and intensity (Nitsche & Paulus, 2001). Early animal studies have demonstrated that tDCS induces cortical excitability changes via the modulation of neuronal resting membrane potentials (Bindman et al., 1962). Generally it is stated that current flow in an anodal direction causes depolarization, whereas cathodal stimulation induces a hyperpolarization of the resting membrane. TDCS itself cannot elicit action potentials; its application causes the spontaneous firing rate of neurons underneath the stimulating electrode to either increase or decrease depending on the direct of current flow (Bindman et al., 1962; Purpura & Mcmurtry, 1965). TACS is understood to induce alterations in cortical excitability via entrainment of ongoing cortical oscillations. This is due to the sinusoidal nature of the stimulation, as well as the ability to apply a wide range of stimulation frequencies (Antal & Herrmann, 2016). Each of these methods has been shown to induce plasticity-like after-effects that outlast the duration of stimulation (Antal et al., 2008; Nitsche & Paulus, 2001; Rossi et al., 2009).

Of the transcranial electrical techniques, tDCS is the most often used in studies seeking to modulate motor behaviors or cognitive processes. Due to its bipolar properties and long-lasting after-effects, it can be used to induce either excitation or inhibition in targeted cortical regions. It is important to note, however, that neural structures surrounding the targeted area may also be inadvertently affected by exposure to the stimulation (Filmer et al., 2014; Keeser et al., 2011). Therefore, care must be taken to apply tDCS with the most appropriate montage and optimal stimulation parameters, relative to the anticipated outcome. Current distribution modeling studies are increasingly useful for this purpose, as they give an accurate indication of current distribution in tissues and peak electric field under the stimulating electrodes (Opitz et al., 2015). Such approaches enable researchers to more precisely identify the neural impact of the stimulation accompanying the behavioral changes, for instance, modulations of the propensity to mind wander, or even the contents of mind wandering.

Auditory Beat Stimulation

Auditory beat stimulation (ABS) is emerging as a promising new method to safely and reversibly modulate cognitive processes. Recent studies have reported the effects of ABS on mood, anxiety, cognition, and pain perception (Chaieb et al., 2017; Ecsy et al., 2017; Garcia-Argibay et al., 2018). Auditory beat stimulation studies have focused on the application of two main types of auditory beats: binaural and monaural. These beats differ in application and how they exert their effects. Broadly speaking, monaural and binaural beats are generated when sine waves of nearby frequencies are presented to either one or both ears simultaneously (monaural) or to each ear separately (binaural). Monaural beats are physical, acoustic beats which are heard when two sine waves at neighboring frequencies are superposed and presented to one or both ears, resulting in an amplitude modulated signal. The

beat itself corresponds to the difference between the two frequencies; for example, two nearby frequencies of 200 and 220 Hz would produce an acoustic beat of 20 Hz. The binaural percept, however, is created when sine waves of neighboring frequencies are presented to each ear separately. This beat, as opposed to those objectively heard during monaural beat stimulation, is subjective and feels like it is located "inside" the head. The beat itself, as in the case of monaural beats, corresponds to the frequency difference between the individual sine waves presented. The binaural beat percept was first described by Wilhelm Dove and can only be detected with carrier frequencies below 1000 (Licklider et al., 1950; Oster, 1973; Dove, 1839).

Of importance to note is how monaural and binaural beats are processed differently in the brain. Monaural beats are detected by the ears and then relayed via the auditory pathway, interacting at the level of the cochlear, where sound information is further relayed to the brainstem and inferior colliculus and processed in the auditory cortex. Binaural beats, however, are perceived when brainstem neurons in the superior olivary nuclei, phase-sensitive to intra-aural shifts, fire action potentials at a rate corresponding to the phase difference between both ears. This interaction produces the binaural beat percept (Kuwada et al., 1979). As a result, monaural and binaural beats are often termed "peripheral" and "central," respectively (Draganova et al., 2008). Although ABS is a relatively novel neuromodulatory tool, recent studies have demonstrated its ability to induce electrophysiological effects in medial temporal lobe regions associated with memory processes (Becher et al., 2015; Derner et al., 2018). Based on intracranial EEG (iEEG) data acquired from presurgical epilepsy patients, Becher et al. (2015) reported changes in iEEG power and phase synchronization after monaural and binaural beat stimulation, in medial temporal lobe structures, including the hippocampus.

Studies examining the impact of ABS on cognition, mood, and pain have often yielded contrasting results, in particular concerning the effects of binaural beats. Monaural beats, on the other hand, have been somewhat overlooked with regard to cognition, mood effects, and other targets of stimulation. Such studies often report weak effects that do not persist much longer than the stimulation duration itself and do not implement measurement techniques like EEG in order to quantify electrophysiological effects (for a review see Chaieb et al., 2015).

Modulation of Mind Wandering by TDCS and ABS

We know we are mind wandering when our attention becomes decoupled from an ongoing task and instead becomes associated with thoughts and feelings unrelated to the current task at hand (for a review see Smallwood & Schooler, 2015). While this can be mentally refreshing, and can sometimes promote creative thinking (Baird et al., 2012; Leszczynski et al., 2017), persistent mind wandering can often lead to a decline in mood states (Killingsworth & Gilbert, 2010) and in extreme cases rumination (Stawarczyk et al., 2013). This negative aspect of mind wandering lends

itself as a target for NIBS and ABS. Up to now, tDCS and ABS have been used to investigate their potential to modulate mind wandering.

Studies Using tDCS to Alter Mind Wandering

Even though much research has been dedicated to mind wandering, to date, very few studies have examined the effects of noninvasive brain stimulation on this cognitive process, and even fewer have looked at its effects on meta-awareness. Altogether only nine studies, all utilizing transcranial direct current stimulation, have investigated the impact of NIBS on mind wandering (see also Chaieb et al., 2019). As we will see, these studies report inconsistent or absent effects of tDCS on mind wandering. This may be, in part, due to a number of methodological differences, which will be discussed in more detail further on in this section.

Axelrod and colleagues conducted the first study investigating the effects of tDCS on mind wandering (Axelrod et al., 2015). They applied anodal tDCS at 1 mA over the left dorsolateral prefrontal cortex (DLPFC), with the return electrode (the cathode) over the right supraorbital ridge, for 20 minutes. To control for unspecific tDCS effects, they applied sham stimulation conditions comprising of anodal tDCS over occipital lobe, and also using the DLPFC montage, with stimulation lasting only 2 minutes. During stimulation, participants were asked to perform a variant of the sustained attention to response task (SART), widely used as a measure of mind wandering (Christoff et al., 2009; Robertson et al., 1997). Episodes of mind wandering were assessed using experience sampling probes, which were intermittently and randomly presented during the SART task. In this study, Axelrod and colleagues reported an increased propensity to mind wander during anodal tDCS over the DLPFC, compared to the control conditions. However, tDCS had no impact on the performance of the task (Axelrod et al., 2015). In a subsequent study, Axelrod et al. (2018) aimed to replicate their earlier findings in addition to assessing the effect of tDCS on meta-awareness of mind wandering. Here, in addition to the mind wandering probe, they also asked the participants to assess their level of meta-awareness during the task ("To what extent have you been aware of where your attention was focused?"). The authors reported findings that were in line with their previous study: that anodal tDCS over the DLPFC increased the propensity to mind wander, compared to the sham stimulation conditions. Again, anodal tDCS did not impact upon task performance. They also noted that meta-awareness was unaffected by the stimulation and that similar to an earlier study by Christoff et al. (2009), high levels of meta-awareness were associated with a decline in mind wandering (Axelrod et al., 2018; Christoff et al., 2009). Taken together, these studies suggest a role for tDCS in the modulation of mind wandering. In another attempt to replicate the findings reported by Axelrod et al. (2015, 2018), by an independent group, Boayue et al. (2019) published the results of a preregistered, multicenter study. Here, the authors utilized the same stimulation parameters and experimental procedure, within a much larger cohort of 192 participants. In this study, no effect of anodal stimulation

of the DLPFC was found, either on mind wandering or task performance. The authors reported, instead, evidence of absence of any stimulation-related effects, based on analyses derived from Bayesian statistics (Boayue et al., 2019). The initial study by Axelrod and colleagues was the first of three to apply tDCS over the DLPFC. The six remaining studies applied tDCS in similar montages, but over heterogeneous regions associated with the default mode and executive control networks.

In the first of two studies applying tDCS over the left prefrontal cortex (LPFC: site of active anodal stimulation) and right inferior parietal lobule (rIPL: site of reference electrode), Kajimura and Nomura (2015) reported that the propensity of participants to mind wander, compared to sham stimulation, significantly increased. In the reverse montage, however (cathode over LPFC and anode over rIPL), the authors reported the opposite effect, in that the propensity to mind wander declined (Kajimura & Nomura, 2015). The authors also observed an effect of tDCS on a flanker task that participants were asked to perform post-stimulation and during which the mind wandering probes were collected; the load dependence of target detection accuracy was reversed for the stimulation conditions, compared to the sham condition. In a further study, using the same stimulation conditions (tDCS at 1.5 mA for 20 minutes) and montages, Kajimura et al. (2016) investigated this increase/decrease in propensity to mind wander using fMRI. Analyses of data derived from this experiment indicated that anodal stimulation of the rIPL resulted in diminished afferent functional connections of the posterior cingulate cortex (PCC) from the rIPL and medial prefrontal cortex (mPFC). Further examination of the data using mediation analysis showed that connections from the rIPL to the PCC suppressed mind wandering, while those originating in the mPFC to the PCC facilitated it (Kajimura et al., 2016). In another fMRI study, and using a different stimulation montage, Kajimura et al. (2019) aimed to explore the impact of functional asymmetry between the IPLs, on mind wandering. They did this by applying anodal tDCS to the right and left IPL (using the contralateral cheek as the return electrode) alternately. The experience sampling probes in this study were similar to those implemented by Christoff et al. (2009), in that levels of meta-awareness were also assessed. The authors reported a decrease in the propensity to mind wander for stimulation over the rIPL versus sham condition, but not for the lIPL. However, stimulation of the lIPL resulted in a decrease in reaction times during the execution of the SART task. Analysis of the blood-oxygen level-dependent signals during resting state revealed that only stimulation of the rIPL modulated default mode network connectivity, compared to sham stimulation. No effects of the tDCS stimulation were reported on meta-awareness (Kajimura et al., 2019).

In a recent study, Coulborn et al. (2020) aimed to investigate whether stimulating the default mode network using tDCS could alter the propensity to mind wander in a double-blind, counterbalanced study. The authors applied anodal, cathodal, and sham tDCS (1.5 mA, 20 minutes) to the right IPL of 23 healthy participants prior to and after completing a SART with intermittent experience sampling probes. By targeting the rIPL (the return electrode was placed over the left cheek), the authors aimed to elucidate whether the default mode network was primarily responsible for the modulatory effects on the propensity to mind wander reported in previous

studies that targeted both the default mode and executive control networks (Coulborn et al., 2020; Kajimura et al., 2016). Similar to Boayue et al. (2019), the authors found no evidence that tDCS over the rIPL was able to modulate the propensity to mind wander. In fact, the two groups found evidence to the contrary, in that using Bayesian (Boayue et al., 2019) and Frequentists (Boayue et al., 2019; Coulborn et al., 2020) analyses they found strong indications supporting the lack of an effect of stimulation in both behavioral and subjective measures of mind wandering.

Using another approach with an alternative brain region and stimulation parameters, Bertossi et al. (2017) examined the role of the medial prefrontal cortex (mPFC) in mind wandering. The authors applied cathodal tDCS over the mPFC for 15 mins and at an intensity of 2 mA. The return electrode was placed over the right deltoid. They asked participants to perform a variant of the choice reaction time task, where subjects were presented with a number stream consisting of digits shown in two colors, one often and the other infrequently. Subjects were required to report whether the infrequently presented color was an even or odd digit. The task was interspersed with experience sampling probes. In this study, the CRT was performed both prior to and post-stimulation. The authors reported stimulation-induced alterations in the propensity to mind wander (post-stimulation vs. pre-stimulation) that occurred in different directions for cathodal mPFC stimulation, when compared to the control conditions. This effect, however, was only observed in male participants and not in the female cohort. In addition, male participants also showed changes in the self-relatedness of mind wandering for all stimulation conditions (occipital control and active mPFC) (Bertossi et al., 2017).

In a final, preregistered study, Filmer et al. (2019) investigated the effect of stimulation polarity and intensity on mind wandering, by applying anodal and cathodal stimulation to the left prefrontal cortex. In a large sample of 150 participants, the authors applied tDCS in both anodal and cathodal polarities to the lPFC (position F3, reference electrode placed over the right contralateral orbit), and cathodal stimulation is applied at 1, 1.5, and 2 mA. Anodal stimulation was applied only at 1 mA. Participants performed the SART with periodically presented thought probes (Filmer et al., 2019). Filmer et al. (2019) found that cathodal tDCS modulated mind wandering, in that the propensity to mind wander increased, in contrast to findings previously reported by Kajimura and colleagues (2016) and Kajimura and Nomura (2015). The authors also reported that the effect of cathodal tDCS was dose dependent, showing a linear trend with strongest effects being apparent at higher stimulation intensities (in this case, 2 mA). The increase in the propensity to mind wander was quite significant; participants in the tDCS group showed a 31% higher number of task-unrelated thoughts compared to those receiving sham stimulation. Similar to earlier studies, the authors reported no effect of stimulation on task performance (Axelrod et al., 2015, 2018; Filmer et al., 2019). A slightly puzzling aspect of the findings reported by Filmer et al. (2019), however, is that anodal compared to sham stimulation showed changes in mind wandering propensity in the same direction as cathodal stimulation, albeit not statistically significant ($p = 0.111$).

Taken together, as these studies demonstrate, it is increasingly difficult to ascertain which approaches are most suitable when looking to induce long-lasting

modulations with regard to mind wandering, using tDCS. The variation in heterogeneous montages and brain regions targeted with stimulation, the widely varying sample sizes, and, most importantly, the inconsistent and partly contradictory results may call into question the efficacy of this kind of brain stimulation in influencing spontaneous cognitive processes.

Mind Wandering as a Target of ABS

Binaural and monaural beat stimulation have been shown to alter brain activity in regions involved in mind wandering, for instance, mediotemporal regions (Becher et al., 2015; Derner et al., 2018). Until now, only one study has investigated the effects of these kinds of auditory beat stimulation on mind wandering. In this study, 40 healthy participants (20 male and 20 female) were asked to perform a variant of the SART, with experience sampling probes embedded intermittently throughout the task. Simultaneously, they listened to binaural and monaural beats at 5 Hz and 40 Hz for a duration of approximately 30 minutes. Sixty experience sampling probes per experimental run were used to subjectively assess the participants' level of mind wandering (whether the participant was "on" or "off" the task) and meta-awareness ("were you aware that your attention was off-task?"). An overall analysis of the entire cohort, across stimulation conditions, revealed no significant modulation of mind wandering by auditory stimulation. However, a median split of the data into two subgroups – those with a high propensity to mind wander versus those with a low propensity to mind wander during silence – showed an effect of stimulation on levels of mind wandering in the high mind wandering subgroup. The authors reported that 5 Hz monaural beat stimulation reduced the propensity to mind wander in participants who have a greater tendency to do so during silence (Chaieb et al., 2020). The participants' levels of meta-awareness remained unchanged by exposure to the beat stimulation at these frequencies, and the propensity to mind wander was negatively correlated with levels of meta-awareness. Christoff et al. (2009), in an earlier study, showed that meta-awareness during mind wandering reflects decreased activity in default mode network and executive control regions, suggesting a reductive effect of meta-awareness on mind wandering itself. This study highlights a pertinent and important aspect of manipulating mind wandering processes: that brain stimulation techniques may be most efficacious in individuals who exhibit a greater tendency toward mind wandering.

Discussion

The studies investigating the impact of tDCS on mind wandering discussed in this review are increasingly difficult to compare and contrast due to the differences in their methodological approaches, sample sizes, experimental design, and choice of

task including experience sampling probes. Those studies seeking to replicate previous findings often report no effect at all of tDCS on mind wandering, even finding evidence suggesting the lack of an effect (Boayue et al., 2019; Coulborn et al., 2020). For instance, the main difference between the initial study reporting an increase in the propensity to mind wander after anodal tDCS of the DLPFC (Axelrod et al., 2015) and the replication study conducted by Boayue et al. (2019) was the larger sample size in the latter study. The authors found no effect of stimulation either online (during stimulation) or offline (post-stimulation) on mind wandering or task performance. In fact, using Bayesian statistics they calculated that a null effect was ten times more probable than an increase in the propensity to mind wander resulting from anodal tDCS over the DLPFC (Boayue et al., 2019).

As another example, a recent study (Coulborn et al., 2020) sought to re-examine the findings reported by Kajimura et al. (2019). Although this was not an exact replication of the earlier study, Coulborn et al. (2020) investigated the effect of tDCS of the right IPL. Kajimura et al. (2019) previously found that anodal tDCS over the right IPL (with the return electrode placed over the contralateral cheek) decreased the frequency of mind wandering compared to a sham condition. The later study by Coulborn and colleagues sought to address the limitations of the earlier study by also implementing a cathodal tDCS condition and measuring levels of mind wandering not only after but also before stimulation. In contrast to Kajimura et al. (2019) and Coulborn et al. (2020) reported no effect of either anodal or cathodal tDCS of the right IPL on mind wandering or task performance. One possible explanation for this discrepancy is the difference in experience sampling probes used in the latter study: that they were not binary responses ("on task" or "off task") but were graded (Likert scale from 1 to 4: 1 = maximum, 4 = minimum) and may influence the interpretation of the experience of the mind wandering itself. Additionally, the earlier study was conducted in an fMRI scanner, whereas the study by Coulborn et al. (2020) was not. Also important to note is that the findings from the initial study were based on a sample size of 13, whereas the latter study included data measured from 23 participants (Coulborn et al., 2020; Kajimura et al., 2019).

In general, the disparity between stimulation montages and the impact of tDCS on the sites of cortical stimulation may also make the interpretation of the outcomes of these studies much harder to disentangle. For example, the stimulation montage used by Kajimura et al. (2016) and Kajimura and Nomura (2015) in two prior studies targeted the LPFC and IPL concurrently. It therefore, remains inconclusive whether the reported decline in propensity to mind wander can be attributed to the effect of cathodal tDCS over the LPFC or anodal stimulation over IPL, or a complex interplay between the two structures, which are part of the default mode network and executive control network, respectively.

Another important point of note is the timing of the cognitive or motor task relative to the application of stimulation. Studies from the motor cortex indicate that performance of a motor task is enhanced when paired with tDCS (an online effect), rather than when executed after the stimulation (Lefebvre et al., 2012; Marquez et al., 2015; Nitsche et al., 2003). Although the study designs by Axelrod et al.

(2015, 2018) and Boayue et al. (2019) both included an online stimulation sequence, their outcomes were contradictory.

As we see, targeting mind wandering with tDCS is not a trivial challenge, and even small alterations in stimulation parameters, montages, and study designs can yield contrasting results. Regarding electric and magnetic stimulation, so far, only tDCS has been utilized in this function; a recent study employing a novel neuromodulatory technique, auditory beat stimulation, reported an effect of monaural beats at 5 Hz on the propensity to mind wander in individuals who exhibited a greater tendency to do so (Chaieb et al., 2020). This interesting finding may help unravel some of the effects observed from previous studies and may enable researchers to make more informed choices with regard to study design. For example, a mind wandering questionnaire may be implemented initially (e.g., Mrazek et al., 2013), in order to screen for "high" mind wandering candidates, i.e., individuals who show a greater tendency to mind wander.

In addition, since the likelihood of mind wandering within a classroom setting or while attending a lecture is not negligible, tools like tDCS or ABS, which are able to modulate this process safely and reversibly, would be desirable. The high cost of attentional failures during learning can directly impact upon how and whether we are able to retain important information. This, for instance, may translate to our educational performance and ultimately to our job prospects and life accomplishments. Of course, the benefits of brain stimulation techniques allowing modulation of mind wandering have to be carefully weighed against ethical concerns, and possible side effects, and potential overuse risks have to be precisely assessed. Combining useful and effective pedagogical practices like implementing quizzes, group work, or live demonstrations may also aid in mitigating the negative effects of mind wandering, but more evidence is needed to understand why these methods alleviate the urge for distraction (for a review see Szpunar et al., 2013).

In summary, it is still too early to say whether auditory beat stimulation is a superior method to tDCS to modulate mind wandering. However, there are some aspects which do speak in favor of auditory beat stimulation: the easy applicability, the wide availability, the reduced risk of side effects, as well as the appeal to younger participants. Future studies have to show whether the effects of auditory beat stimulation on mind wandering are replicable and robust or not.

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Chapter 9
Education in Agency, Mind-Wandering, and the Contemplative Mind

Oren Ergas

Introduction

Educational practice is based on two assumptions regarding student agency: first, that it exists, namely, that students have the ability to choose what they do or how they act, and, second, that education as a deliberate effort of teachers, parents, or others can lead to the improvement of these choices, at least in as far as they are considered better within the norms of the society in which education takes place. I call the first "the assumption of agency," that is, people can and actually do make choices based on the sense of being free to do so. I call the second "the assumption that education cultivates agency," that is, by means of teaching knowledge, skills, and values, and through modeling, teachers develop in students the ability to practice their agency and make better choices.

These assumptions appear in different ways in the literature. For example, Dewey's (1958) conception of education could be framed as developing the ability to exercise agency in light of a growing understanding of our surroundings and ourselves. Based on deliberate reflection on experience – perhaps the most formative educational practice that Dewey proposed – we learn to adapt the environment to our needs or adapt ourselves to its needs. Growth, as the ideal of Deweyan education, manifests as one's broadening understanding of conditions around him or her, their growing awareness of their own capabilities, needs, and wants and taking into consideration social norms and morality, and their growing ability to determine when and how to act upon the environment and when to adapt to it. Thus understood, growth reflects a cultivated and the cultivation of agency, acquired through knowledge of world and self.

Yet, we often miss a perspective that stems from the fact that the world presents itself one way or another depending on the scale at which it is examined (Olendzki,

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2011). This is an understanding that has been part of physics when considering the difference between Newtonian and quantum physics and in neuroscience when brain functioning is studied at a resolution of brain regions compared to neuronal networks. Educational processes, too, look very different when they are considered from a coarse versus a fine resolution of time (Ergas, 2019a). This applies directly to the understanding of agency and the two assumptions made in respect to its mere existence and the possibility of its cultivation.

There is a difference between "agency as trait" that applies to how we conduct ourselves over long periods of time and "agency as a present-moment lived experience." The former applies to "big chunks" of time beginning with at least a few seconds and as long as years or a lifetime. Examining agency from this coarse perspective allows us to question whether a student, teacher, or any other person indeed *chose* a certain action over the past few seconds or whether the action had occurred without having had the feeling that they exercised any kind of choice prior to its performance (e.g., cursing someone in the heat of the moment).

The finer resolution, however, places a magnifying glass on each moment of experience as it comes and as it goes. One can say that it looks at the parts that make the coarser resolution of agency as a "trait." When examined from such perspective, as this chapter intends to do, the sense of agency becomes far stranger, dubious, and questionable in a way that challenges the two assumptions mentioned.

In order to investigate this finer resolution, a further step is required. Following phenomenologists and cognitive scientists, the position held here is that the examination of human experience cannot be fruitfully conducted without including the lived experience of the person undergoing that experience (Kordeš, 2016; Petitmengin, 2006). This is particularly crucial when considering education and most of all when this concerns internal processes associated with the workings of the mind and the attempt to understand phenomena, such as human agency. The very meaning of an *educational process* can be lost if we focus merely on pre−/post-research designs and neglect the actual experience of the person undergoing the process (Dario & Tateo, 2019). Furthermore, such perspective is not only necessary for *understanding* educational experience; it also carries a clear ethical orientation in its epistemology that corresponds with the ethics of education itself. This is because it shifts from merely looking at the external attempt to improve education through pre−/post-"medical intervention" designs that tend to reflect a behavioristic-mechanistic paradigm to a humanistic approach that attributes at least equal importance to the process. Here the experiences of students who are always considered more important than the end results and the process becomes an end in its own right (Ergas, 2017).

The inquiry proposed here can be described as contemplative inquiry – a first person-based experimental approach by which one examines one's subjective experience (Varela & Shear, 1999; Wallace, 1999) – backed by contemporary research on mind-wandering and mindfulness. This approach is nested within a philosophical argument that is developed from an educational perspective. Eventually it leads to the claim that if indeed we hope that education will cultivate agency, then our current curricular-pedagogical approach has little to offer. Agency begins with

attention, and the cultivation of attention can only occur by means of contemplative practices, such as mindfulness, which are becoming more widely accepted in education (Ergas, 2019b).

Breaking Down Agency in Education

The Coarse Perspective: Integrated Subjects and Their Agency

When examining agency, the sense we have of ourselves as those who will and choose based on being free to do so, we need to ask "what are we the agents *of*?" – that is, what is it that we (can) practice agency *over*? Behind this question stands the attempt to point to and address the weakness in the domain of agency in education that is caused by the coarse resolution by which we engage it.

When unpacking the assumptions of agency and the belief in its cultivation in education, thinking of the day-to-day treatment of schools, it usually applies to students who are viewed from an external perspective as "integrated" human beings. Such perspective ignores the first-person experience of their own embodied minds. When we think in this way, it is unclear how we can explain a variety of situations in which students behave in ways that fall very short of their own ideals. For example, a student might hit or curse another student despite knowing better and possibly say in retrospect that "he had lost his temper." What are we to make of this? Who was the agent of the body that hits the other student or was there no agent there at all? Such idea tends to challenge our sense as indeed agents in our lives; this is, however, in spite of the fact that such situations are hardly rare. Even if most of us do not hit others, we very frequently act in ways that we regret later, and sometimes we even act in these lesser ways while knowing that we will regret this later (e.g., drinking too much, spending too much time on Facebook).

A particularly relevant domain, on which we will focus, is students' mind-wandering, that is, thinking of things other than the task at hand, a situation described in the title of Smallwood et al.'s (2007) paper as "the lights are on but no-one's home." It becomes particularly relevant to agency if we consider a situation in which students want to focus on their studies yet find themselves self-absorbed in thoughts about matters that are completely unrelated to the subject matter despite their intention to listen (Ergas, 2018). Who is the agent within a student in such case? Adding the fact that mind-wandering occurs arguably between 30% and 50% of the time (e.g., Jazaieri et al., 2016; Killingsworth & Gilbert, 2010; O'Callaghan et al., 2015; Seli et al., 2016) points again to the pervasiveness of these (supposedly) "agentless" states that seem to be part of being human (Smallwood & Andrews-Hanna, 2013).

Such phenomena don't only challenge the assumption of agency itself but also the assumption that education can actually cultivate agency. It is not all that obvious that our being educated necessarily means that we lose our temper less or mind-wander less. While to the best of this author's knowledge no study has empirically

examined whether spending years in primary and secondary schooling reduces mind-wandering, the studies mentioned above were conducted with adults, revealing quite substantial amounts of time spent in this state. It doesn't seem too risky to suggest that the process of education might not necessarily cultivate agency at least in as far as being the agents of our own wandering minds is concerned.

So who exactly are we in these moments of mind-wandering? One possibility comes from William James (1890) who claimed that we are "bundles of habits" (online ref.), followed by Yates et al. (2017) who construed the mind as a bundle of competing agencies. There is nothing we do in any moment that can be said to be "against our will." If an action was executed by us or a thought emerged within us, then it was willed by our mind; hence, we are the agents behind the act whether it reflected a good or a bad choice or whether we regret it later or not. Yet we do not tend to think like this. We tend to think of agency more as a transient experience that is not always there. When it is not there, as in "losing our temper" or mind-wandering, we become these "automatons" and claim that "it happened against our will." Yet, this kind of approach is very peculiar and highly problematic from an educational perspective. If we view agency as some transient faculty that arises and passes, then we can't be fully accountable for what we do. It might sound extreme, but claims made in court about "temporary insanity" as a justification for crimes might not be that far off. Essentially what hides behind them is that one has lost his "normal" agency and regained it later. It is hardly the case that those who mind-wander – which appears to be all of us – commit crimes, but it clearly begs an inquiry into the extent to which we are the agents we think we are and what are we the agents *of*.

To conclude this section, looking at students from an external gaze as integrated subjects does not grant us with enough understanding on agency. Inner experiences in which we supposedly will one thing and do another suggest, first, that it might be more helpful *not* to think of students as integrated beings and acknowledge them as complex and *disintegrated* subjects. Second, it suggests that if education does assume agency and aspires to cultivate it, it needs to delve more deeply into the moment-to-moment processes concerned with agency that is associated with the depth of these inner complexities, so that it can indeed cultivate such agency if this is possible.

The Finer Resolution: Disintegrated Subjects and Agency

Following the above begins by considering colloquial language use and life experiences, which disclose the disintegrated subjects that we are. The most common breakdown begins with body and mind. They are not separated here as an ontological commitment but rather as an observation about how we speak (e.g., "I take care of 'my' body") and an acknowledgment of the heritage of dualistic Greek and Enlightenment-based theories in light of which we often view ourselves (e.g., Plato, Descartes). Yet this perspective itself is too coarse and should be further broken

down. When examined through contemplative inquiry, namely, bringing our attention to what we empirically can claim to experience even at this very moment, we find that we do not experience neither "mind" nor "body" as such; rather, we experience "body" as sensations coming from within us that we attribute to this conceptual label. Similarly, we experience thoughts and associate them with the "mind." If we commit to being more exact, then we do not even experience "sensations" nor "thoughts," for these too are broad categories in and of themselves of which we only experience exemplars from moment to moment (e.g., a sensation of *heat* in a bodily area, a thought with the content *what time is it?*).

Following a previous work (Ergas, 2017), I define thoughts as mental objects, which appear as specific words, visual images, or inner sounds; however, I will focus much more on the former given their pervasiveness in our lives. Hence, thoughts are specific words and sentences that I hear within an "inner space" that I associate with my body, usually experienced in the area I call "the head." Sensations, however, are utterly physical. They can be anything, such as heat, coldness, pressure, a tickle, throb, vibration yet stripped of these very words that are only used here to communicate a certain physical experience.

From this perspective, we get a slightly more empirical first-person understanding that lays out some candidates for considering what we are the agents *of*. We can start with asking, are we the agents of sensations? We can test this empirically at least for ourselves by asking:

Can we, for example, elicit a pinching or throbbing sensation in our belly or left pinky?

Not quite. We don't control which sensations we will experience. We can engage in certain activities that are likely to produce certain sensations, but we need to engage in the activity to get those sensations, and we are not guaranteed to indeed get them, e.g., we may hope to eat a good meal, but it might not satisfy us as much as we had hoped. Furthermore, we are certainly not the agents of many of our bodily functions – our digestive, respiratory, or nervous system. When we put food in our mouth, we don't control our saliva and may find ourselves drooling at the thought of a good meal just as good Pavlovian dogs.

Are we the agents of our thoughts? When we look at texts such as Descartes' *Meditations* that crown us as "thinking things," we might get such impression. However, this foundational text is far more a celebration of reason than an acknowledgment of mind-wandering, which at least as considered here is not exactly a part of Descartes' analysis. We can try a similar approach as above suggested and test whether we are the agents of our thoughts:

Can we choose to think about a subject we determine in advance for one full minute without irrelevant thoughts intervening in the process?

It is very unlikely that we will manage to do so. Various other thoughts will intervene in our effort to sustain a chain of thoughts over the same subject. Agency in this respect probably changes from one person to the other, but we will most likely not be in full control of the process.

We can try something even more radical if we want to test our agency over thinking:

Can we stop *thinking altogether for a whole minute, beginning now*?

I doubt whether any reader can do this.

These proposed experiments as well as the evidence of the pervasiveness of mind-wandering suggest that we are hardly the agents of our thinking. We can't think about a certain subject for even a few seconds before unrelated thoughts will appear, and we certainly can't stop our thinking, at least not in any conventional way. Indeed Dewey (1910) acknowledged our wandering minds in claiming: "[M]ore of our waking life than we should care to admit, even to ourselves, is likely to be whiled away in this inconsequential trifling with idle fancy and unsubstantial hope" (p. 2). Importantly, these themes have been described in the educational context:

> Watching older kids study, or try to study, I saw after a while that they were not sufficiently self-aware to know when their minds had wandered off the subject. When, by speaking his name, I called a daydreamer back to earth, he was always startled, not because he had thought I wouldn't notice that he had stopped studying, but because he hadn't noticed.… Most of us have very imperfect control over our attention. Our minds slip away from duty before we realize that they are gone. Part of being a good student is learning to be aware of the state of one's own mind and the degree of one's own understanding. (Holt, 1995, pp. 7–8).

And similarly:

> [I]n teaching, you must simply work your pupil in to such a state of interest in what you are going to teach him that every other object of attention is banished from his mind.…The mind of your own enemy, the pupil, is working away from you as keenly and eagerly as is the mind of the commander on the other side from the scientific general. (James, 1983, p.10).

Both of the latter accounts acknowledge mind-wandering and its implications for the classroom. They suggest that we hardly possess the kind of agency we like to attribute to ourselves or that educational practice tends to assume to exist in students. James expresses this in characterizing the "mind" as such, and Holt further observes that the mind that wanders does so without its "owner's" awareness.

To conclude this section, when looking at agency from this first-person perspective, we become more knowledgeable about these inner processes. We seem to be disintegrated beings, at least in as far as our ability to will certain mental processes (e.g., think about a certain matter, attempt to stop thinking, attempt to focus on a task) with our minds opting for something other. While this is certainly unflattering, it at least helps place a finger on the problem of agency more clearly. For our context, it is important to position this in light of our curricular-pedagogical approach and how it relates, or rather does not, to this conundrum of agency.

The undergirding assumptions behind our curricular-pedagogical approach tends to have an integrated subject in mind. Looking at the kind of subject matter we teach and how we teach it, we will not find anything there that somehow reflects the fact that the mind of the student might be miles away. The only strategies we have are to interest students or to ask them to "pay attention." There is nothing in our curriculum that teaches students *how* to become present to the tasks at hand when they wander. James, in fact, lays the entire burden over the teachers' shoulders who are to ensure that students stay interested, and Holt, beyond arguing that students need

to learn to become aware of their own states of mind, does not leave us with a practice that teaches them how to do so. Some might think that Dewey's (1910) reflection can help here, but a mind that is predisposed to idle fancy, as Dewey himself acknowledged, is not one that is fit for reflection. Reflection, as a form of deliberate and aware thinking, cannot occur unless there are certain conditions that it itself does not bring forth (Ergas, 2016, 2017).

Importantly, the direction that James takes, which is generally how we go about in education research and practice, that is, attempting to tweak teaching methods so that students will be disposed toward learning, will never fully address mind-wandering because of two reasons: First, wandering has been associated with the default mode of brain operation (Raichle et al., 2001) and some observe that it is crucial for healthy development (Immordino-Yang, 2016; Dario & Tateo, 2019); hence, minds *will* wander because it is part of being human. Second, a teacher will never manage to interest 20 or 35 students with different inclinations and characters throughout lessons.

The suggestion here is that Holt's final sentence does offer a hint as to where we should be going. There seems to be a need for pedagogies that teach students to become more aware of what goes in their mind. Even if wandering is natural, it is still problematic to have students space half of their days. Just consider how ridiculous saying that a child is "at school" if half of the day she is "schooled in her own mind" (Ergas, 2018). The position here is that there is nothing wrong with the idea that education should cultivate agency; the only thing wrong here is that our curriculum is not designed to do so. The pedagogies needed for such task require further breaking down the nature of agency. This will eventually lead us to the inevitable conclusion that such pedagogies can only be enacted by the student (or teacher) over him or herself.

Mind-Wandering, Mindfulness, and Agency

The meaning of agency as I propose it here implies a sense of an "I" that wills his mind and body toward action and thought. This should be separated, however, from the question of "free will." The question here is not whether or not what we think and do is determined by the past and leads toward a predetermined future; it is about the first-person experience of being aware that I am choosing what I think and do. The ontological question of whether such sense of agency is false or not is one that, like Kant, I leave outside the scope of our knowing.

I define mind-wandering as a state of mind of which we are *not* the agents. We do not choose to wander but rather find ourselves wandering, and when we find ourselves wandering, wandering stops at least for that moment (Ergas & Berkovich-Ohana, 2017). We can create or be situated in situations that are likely to produce more wandering if these are specifically boring, but even then we will not choose the onset of wandering.

Our lack of agency in regard to mind-wandering comprises of a two-layered conjoined habit (Ergas, 2016, 2017). The primary layer concerns the habit of shifting between mind-wandering and presence, which determines when and how much we wander. The second layer comes into play once we wander and concerns the kind of content we experience as our minds wander, i.e., *what* we think while wandering. We are the agents of neither of these levels.

When I teach courses on these themes, students find them very difficult to handle. They ask the following: "If I am not the agent of my thinking, then who is? How can a thought arise in the mind without me being its thinker?" A good experiment that quickly situates students in a position to discuss mind-wandering and agency is the following, which the reader can try:

> Set a timer for 7 minutes. Try to make a commitment to stay with this exercise. Set yourself comfortably on a chair. If you wish, close your eyes. Bring your attention to your abdomen and take three intentional breaths to get a feel for that area. Now let your breathing fall back to its normal pattern (slow/fast/shallow/deep, whatever it is is fine). As best you can, in the next 7 minutes, keep your attention on the sensation of the breath in the area of the abdomen. If anything else comes to mind, or if you find that attention had wandered away from your abdomen, just make a mental note of wandering once you note it, and simply bring your attention back to the sensation of the breath in your abdomen. Keep this up until the timer signals that 7 minutes had passed.

Given experience with hundreds of students, I am quite sure that if the reader tried this, she or he probably had serious difficulties directing attention solely to the sensation of the breath in the abdomen. The following are possible scenarios that unfolded:

1. You just couldn't do it or felt that you didn't want to despite committing to it in the beginning. After a couple of breaths, you stopped. It seemed futile.
2. You managed through the task here and there but were taken by mind-wandering. Thoughts came up in your mind, and you spent much of the time thinking of other things.
3. You fell asleep or was in some twilight zone that's close to it.
4. After a moment or two of focus, a thought came to mind that you can actually use this time to plan your day ahead now that you're so focused. You worked on your "to-do list" and spent much of the time planning the near or far future.
5. You somewhat managed to be with the breath throughout, but several other things caught your attention (e.g., thoughts, pain in the back), and from time to time you "phased out" for indiscriminate periods of time.
6. You stayed focused on the breath, but it felt like a battle. Thoughts kept barging in, and you used a lot of your mental energy to ward them off. At the end of the session, you were close to a headache, possibly your body felt tight, and you may be missing some oxygen now.

Some might say that such test of agency raises the bar too high, that is, a mind is not supposed to do such things. I suggest that it is by posing such test that we can explore the heart of agency, yet we do so in a manner that is even more nuanced and subtle than considered above. This is because this experiment situates "attention"

and not "thinking" as the fulcrum of agency (Ergas, 2017). In this, we follow a line of philosophers and psychologists who attributed utter importance to our faculty of attention (e.g., Csikszentmihalyi, 1991; Weil, 1986). Among them, James (1890) perhaps coined it best: "for the moment what we attend to is reality" (online ref.). Every moment in which we experience something, it is because we had attended to it. Had we attended to something else, then that other thing would have constituted our reality for that moment. When looking at agency through this moment-by-moment prism, we come to see the entire drama of life as the battle over attention. As Csikszentmihalyi (1991) put it: "Information enters consciousness either because we intend to focus attention on it or as a result of attentional habits based on biological or social instructions" (p. 30). The "battle" over attention is framed by the question: who or what will determine where attention will go, will this be me or someone/something else? The assumption here is that acts that are justly referred to as "agentic," i.e., such that we have literally chosen with a lucid awareness, begin with the attention that was willed in that direction. The more agency I possess over the faculty of attention, the more I can define my experience and also experience myself as making choices and willing actions.

Turning to James (1890) again, we will find that he connected this directly to ideal education: "The faculty of voluntarily bringing back a wandering attention, over and over again, is the very root of judgment, character, and will...An education which should improve this faculty would be the education par excellence" (online ref.). James seems to point to my above observation, namely, that behind acts of judgment, character and will stand voluntary attention, which is suggested here as the fulcrum of agency. For James attention and agency were two sides of the same coin. The very mental act of willing our attention somewhere requires attention in and of itself, which requires will.

Importantly, if the reader is unfamiliar with it, it may be time to break the news that the experiment proposed above is a form of *mindfulness practice* in a version often referred to as focused attention (Kabat-Zinn, 1994). It is a meditative practice, originating in Buddhism, yet one that can be practiced without commitment beyond the acknowledgment of first-person experience. As above, it can be simply considered as an introspective method by which to experiment and develop a firmer grasp over understanding the phenomenology of experience (Kordeš, 2016). It allows us to better understand what happens during a process and not merely within a pre–/post-framing that does not disclose the actual experience as it unfolds, as often done in educational research and in the study of mind-wandering in particular (Dario & Tateo, 2019).

Experimenting with mindfulness as above is like placing a magnifying glass over agency and the battle over attention. One moment we will our attention toward the breath as requested, and in the next we find that it has been "hijacked" either by some external noise or by thoughts with content that can span anything from things that have to do with the experiment itself (e.g., how much time has passed?) or with things that are completely unrelated to it (e.g., what we plan to have for lunch). From the perspective proposed here, in the former moments, we experience agency because *we* define where attention goes, and thus the reality we attend to; in the

latter moments, reality is defined, not by us but *for* us. To be sure, however, it is still our own minds that are involved in this, for it is the faculty of attention from within our mind that is being lured to stimuli that are other than the breath; nevertheless, in those moments, which can be many, we do not have a sense of agency as I defined it.

This peculiar situation connotes with the abovementioned possibility of seeing ourselves as "bundles of habits" with competing agencies, residing within one mind following Yates et al. (2017): "the mind is not a single thing, but rather a collective of many different mental processes" (p. 91). In order for a series of moments to become a chain of events that revolve around a single activity associated with agency (e.g., focusing on a mathematical problem, attending to the breath), there is a need for a process of unification of intentions, such that these different processes will be directed toward it. There is a need for a certain agency to reign over others keeping them at bay. Embracing this view, mind-wandering is a process in which the mind brings to awareness thoughts that are unrelated to the activity in which we are engaged as part of that "battle over attention." It is a process that disintegrates the subject as it takes the mind away from being fully invested in the present moment of embodied existence. Behind Holt's observation, there is an acknowledgment of this exact situation as well as the claim that students need to learn how to be more agentic in relation to their own minds, that is, how to integrate attention, awareness, and the present moment.

Importantly, however, we should consider theories that attribute a functional and important role to these very situations (e.g., Dario & Tateo, 2019; Immordino-Yang, 2016; McMillan et al., 2013) in which according to my perspective we lose our sense of agency. For example, if we mind-wander at times when there is no significant need to fully attend to a task at hand, perhaps this should be considered as the mind's economic way of handling time (Smallwood & Andrews-Hanna, 2013). We should also consider that our lack of agency of our thinking may be the very point of thinking as such. Solutions to problems require some kind of freedom of the mind that enables us to overcome rigidity in our ways of thinking (Ergas, 2017). As Baars (2010) argued we also may be assuming too much when we automatically believe that mind-wandering is task-irrelevant. The ways in which minds work are far more mysterious, and solutions to problems and creative moments may well be associated with this state of mind.

These are valid arguments when directed at the phenomenon of mind-wandering as a whole, yet along with them we have to consider that mind-wandering has mostly been associated with negative rather than positive effects in general and in the educational context (Ergas & Berkovich-Ohana, 2017). This applies, for example, to our emotional lives (Killingsworth & Gilbert, 2010), our likelihood to engage in compassionate acts (Jazaieri et al., 2016), and our cognitive functions associated with a variety of tasks (Mooneyham & Schooler, 2013). This suggests that mind-wandering may work against attempts to orient education toward well-being and morality (Noddings, 2003, 2010; Gilead, 2012). However, more directly related to the theme of this chapter, we should not think here in terms of "reducing mind-wandering." This is about cultivating agency over our own mind, an idea that seems

almost trivial for education and yet our curriculum has very little to offer in this respect. What are we to do?

Conclusion: Toward an Education in Agency Informed by Mind-Wandering and the Contemplative Mind

Following the above considerations, we seem to have two options: either admit that current curricular-pedagogical approaches cannot assume nor cultivate agency at least as considered here at the moment-to-moment level or introduce pedagogies that might address education in agency in a more robust and direct way. In the following conclusion, I briefly explain why we should go with the latter and point to *how.* In making this claim, I acknowledge the abovementioned arguments as to the importance of mind-wandering as a process that potentially yields meaning-making that is crucial for our lives and, in fact, for education. In this sense, my argument has little to do with trying to eliminate mind-wandering, which I do not see as possible nor desirable. Rather, I argue that we need to cultivate agency because we are shaped by what we experience whether it comes from deliberate thinking from within, external pedagogies enacted by teachers, *or* non-deliberate inner processes, such as mind-wandering. As I put it elsewhere, we are "schooled in our own minds" (Ergas, 2018). This is because minds constantly respond to experience even if that experience is a thought that came up from within that very mind. Importantly, this does not merely affect us; it also affects others as some studies show that we are less likely to engage in compassionate acts the more we wander (e.g., Jazaieri et al., 2016). This makes sense, if we consider that one who is absorbed in his own mind has no place for the suffering of others. Hence understanding what goes on in our minds is not merely to enhance our ability to dispose ourselves toward learning as Holt (1995) suggested above; it is also to put us in an aware position to reflect over our experience as Dewey (1997) thought we should and to make us more present for others around us.

If we believe that agency should be an orientation of education, as I tend to think we do, we need to stop assuming that it is there or that we are cultivating it through current curricular-pedagogical approaches that have been shown to have little to do with cultivating attention – the fulcrum of agency. We need pedagogies, like the above proposed experiment, that position agency at their center. Simply put, if we want to develop a certain capability, we have to practice it directly.

The arena that grants us with this possibility lies in the field of contemplative practices, which can be characterized and defined in a variety of ways. Most emerge from wisdom traditions, such as Buddhism (e.g., mindfulness) and Taoism (e.g., Tai chi); however, as above, the emphasis suggested here is on the main pedagogical movement that these practices engender, which concerns the turning of attention inward (Barbezat & Bush, 2014; Ergas, 2019b). A helpful definition of these practices has been offered by a group of some of the leading neuroscientists,

psychologists, and educational scholars involved in the study of this domain, who claimed that:

> A defining characteristic of such practices is that they require individuals to exercise volitional control to sustain the focus of attention on particular objects (such as the breath) or mental contents (such as the suffering and relief from suffering of particular individuals). Other objects of attentional focus may include moment-to-moment fluctuations in the "stream of consciousness" in order to develop the ability to concentrate, to effectively understand and manage stress and emotion, to gain knowledge about oneself, and to cultivate prosocial dispositions. (Davidson et al., 2012, p. 147)

As in the experiment above, which reflects mindfulness – currently the most studied and implemented contemplative practice (Black et al., 2019) – practicing contemplation is exercising volitional control "to sustain the focus of attention on particular objects" as appears in the above definition. Whether one practices mindfulness and applies attention to the breath, or whether one practices a yogic posture and applies attention to various principles of practice and their enactment over and within one's body, these practices are pedagogies that transpose the arena of education from the teacher-student sphere to a personal educational sphere, or one's "inner curriculum" if you will (Ergas, 2017, 2018), that is, they require us to engage directly with ourselves and become attuned with our fluctuating states of mind. Notably, this has to do with noticing when the mind had wandered, what kind of content it brought, and bringing attention back to the present moment of experience. With every such episode of bringing back that wandering attention, one works directly to cultivate agency.

The evidence on the effects of mindfulness on attention have been growing substantially in the past decade, with some studies demonstrating improvement in certain aspects of attention (Moore & Malinowski, 2009; Mrazek et al., 2013; Tarrasch, 2017). Some studies have also shown that mindfulness reduces mind-wandering (Schooler et al., 2014), but taking into consideration the abovementioned claims, we should remember that reducing mind-wandering may come at a price if it is indeed conducive to meaning-making. At the same time, there seems to be a need for more nuance in this domain as some have already acknowledged (Christoff et al., 2016; Ergas & Berkovich-Ohana, 2017; Dario & Tateo, 2019). Mind-wandering is not a uniform phenomenon. For example, some speak of intentional and unintentional mind-wandering (Seli et al., 2016), an observation that is sometimes missed even in well-cited studies (e.g., Killingsworth & Gilbert, 2010). The definition suggested here for mind-wandering does not accord with intentional mind-wandering, for intention here is interpreted as agency – a quality that is missing in mind-wandering. If one intentionally chooses to allow his mind to wander, and deliberately engages in attending to what occurs in the mind when it wanders, this begins to look more like a contemplative practice rather than "intentional mind-wandering." In this sense, Ergas and Berkovich-Ohana (2017) proposed a view of agency in these states as lying over a spectrum rather than as a binary. The advancement of this field requires more of these observations, and the only way to achieve them is to develop ways in which to examine states of mind as they move between presence and absence, mindfulness and absent-mindedness. The only educationally meaningful

way to do this is to incorporate first-person perspectives and second-person methods through which first-person experiences are made sense of (Kordeš, 2016; Petitmengin et al., 2017; Dario & Tateo, 2019; Wallace, 2004). Based on such methods, an education in agency can become more informed as to how to teach students and teachers to engage their contemplative minds.

Without the incorporation of contemplative practices in the curriculum, the assumption of agency and its cultivation by educators seems naïve, very coarse, and, possibly, just false. Research on the implementation of contemplative practices in education (mostly around mindfulness) shows promise (Ergas & Hadar, 2019; Weare, 2019). They open a realm of possibilities that recruit one's mind for the cultivation of one's mind. Alongside the disciplinary knowledge and skills taught in schools, it seems crucial to move in this direction, if we indeed wish education to stand on firmer grounds in its attempt to cultivate agency.

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Chapter 10
A Contemplative Perspective on Mind Wandering

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Mind Wandering

The content of our thoughts is not bound to the here and now. It is possible to remember the past and imagining the future. This is referred to as "the monkey mind" by Buddhists or simply mind wandering (Bartok & Roemer, 2017). Studies suggest that we spend about 50% of our time engaging in mind wandering (Killingsworth & Gilbert, n.d.; Smallwood & Andrews-Hanna, 2013). We either reconstruct past events or play out hypothetical future situations in our thoughts suggesting that mind wandering can be viewed as a sort of mental time travel. Studies suggest that this takes place when the mind is idle with no apparent task to perform. Therefore, mind wandering is also known as "task-unrelated thinking" (Allen, 2013; Denkova et al., 2019). Task-unrelated thinking is the baseline of mental activity when we are at rest but still awake and is also known in neuroscience as the "resting state" and can be measured using EEG (Campbell et al., 2012; van Son et al., 2019). Other brain scanning techniques, such as fMRI, have identified activity in distinct regions of the brain when we are idle and engage in mind wandering. These areas are called the default mode network (Andrews-Hanna et al., 2014; Davey & Harrison, 2018; Mason et al., 2007).

Mental time travel between memories and imagined future scenarios also serves as a source for our sense of self and correlates with activity in the default mode network that has also been called the center of gravity for the experience of the self (Davey & Harrison, 2018). Discursive psychology has long held the claim that memory and remembering are two separate acts that inform a sense of self by helping to maintain an ongoing narrative of who we are (Prebble et al., 2013; Smallwood et al., 2011) and what is remembering, if not an act of mental time travel, or mind wandering, into past events. Mind wandering is an action, the content of which can

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have the appearance of thematic constructions, such as inner narratives of imagined scenarios, casting the sense of self in the main role. We prospect the future for outcomes of our actions, imagining the self in new roles. Patients with depression show a bias toward certain memories that in turn inform their sense of self (Nejad et al., 2013; Whisman et al., 2020). The same goes for patients with anxiety. Research showing that we spend half our waking hours mind wandering suggest that mind wandering captures the attention. We often hear phrases such as "sorry, I was lost in thought" when we confront others with their seeming inattention to what we are saying, for instance. It is not that the listener was caught up by their action of mind wandering but rather the content of mind wandering – being "lost in thought."

Mind wandering is a common occurrence, taking up almost half of our waking hours (Killingsworth & Gilbert, n.d.; Smallwood & Andrews-Hanna, 2013). Mind wandering is also known as task-unrelated thoughts (Smallwood et al., 2003) because it diverts attentional resources away from the task at hand and redirects it at internally constructed scenarios, giving rise to unrelated emotion and thoughts (Smallwood & Schooler, 2006). Mind wandering can occur, involuntarily, during an activity and is defined as thinking of something else while executing, or engaged in, a task (Mason et al., 2007). In this regard, rumination and worry, key factors in clinical depression and anxiety, can be considered mind wandering.

Rumination is defined as "going over in the mind repeatedly" by Meriam Webster. Rumination is also defined as the process of continuously thinking about a negative affective state of mind, its indications, its cause, consequence, and meaning. (Ramel et al., 2004).

Rumination may play a reciprocal role in depression, being both a precursor and the result of depressive symptoms in adults. Rumination may lead to depression, but depression may also lead to cognitive changes that in turn exasperates rumination further, leading to symptoms of depression (Whisman et al., 2020). Rumination is a form of self-referential processing.

Self-referential processing is the way in which we experience and think of phenomena or stimuli that relates to the self. Pictures of our own childhood are perceived differently than pictures of random people due to how the internal story of the self, or self-narrative, is invoked through autobiographical memory (Farb et al., 2007; Nejad et al., 2013; Northoff et al., 2006).

Rumination involves thinking about indications and signs of how things have manifested. Rumination also involves thinking about causes of mood, which in turn requires probing the past for the origins of the current situation. Both indicate a past tense frame of mind. Rumination becomes self-referential because it relates the past to the current self (Nejad et al., 2013). Searching for meaning and probing for consequences indicates an often involuntarily attentional lapse into temporally unrelated themes, i.e., mind wandering.

Research indicate that mind wandering correlates with negative mood and depressive symptoms. Specifically, correlations between negative mood and a higher frequency of past-oriented mind wandering have been found (Smallwood & O'Connor, 2011) which suggest that there is a tendency to be biased toward past tense mind wandering when it comes to negative mood.

Worry, according to Meriam Webster, is defined as "mental distress or agitation resulting from concern usually for something impending or anticipated." Worry interferes with the present moment orientation by focusing the attention on a possible scenario, temporally situated in the future. More than 90 percent of worries never come to fruition, meaning that a lot of resources are spent on mentally engaging in a future-oriented scenario that will never happen (LaFreniere & Newman, 2019). Worry is also a core factor in clinical anxiety, the treatment of which is often targeted at the irrational automatic thoughts that accompany anxiety disorders (Hope et al., 2010).

Anxiety is a reaction to a perceived, *anticipated* threat situated in a future-oriented timeframe, according to the World Health Organization classification of anxiety. Research suggest that this anticipation is accompanied by mind wandering where future-oriented thoughts, involving a possible threat, are woven into a narrative (Capps et al., 1997). Anxiety is not to be mistaken for fear; fear is a response to a perceived, *immediate* threat, situated in the present.

Anxiety increases mind wandering (Hofmann et al., 2010; Xu et al., 2017) and repetitive, intrusive thoughts and worries (McLaughlin & Nolen-Hoeksema, 2011). Anxiety reduces executive control (Bishop, 2009) and impairs attention, when measured on the Sustained Attention to Response task scale (Bishop, 2009; Grillon et al., 2016).

Worry and even anxiety are not merely negative states of mind. Both have served the human race well throughout history. It is worry and anxiety that keep us up at night, monitoring the environment for wild animals and thereby increasing our chances of survival. In modern times, you are far more likely to be hit by a car than come across a wild animal, but it is that same worried state of mind that keeps you alert when crossing a road. We come across other dangers as well, not only to our immediate physical health, but threats to our livelihood, in the form of job security, and to our identity as parents, students, teachers, and so forth. There are even threats from norms and societal demands. This constant threat over-activates the base responses of anxiety turning a survival tool into a burden.

Mind wandering is not only correlated with disorders such as clinical anxiety and depression but also negatively impacts everyday activities. Mind wandering is correlated with errors in performance and memory, manifesting in poor academic achievement (Allen, 2013; Kane & McVay, 2012; Mooneyham & Schooler, 2013; Smallwood et al., 2007; Smallwood & Schooler, 2006).

Worry, rumination, imagined futures, and prospective outcomes that may or may not materialize to our temporary joy or disappointment all share a common theme of temporally shifting attention. This happens when we are idle and often unintentionally. Attention wanders from points of focus in the past to imagined futures. This temporally shifting attention is regarded as a cause of suffering in contemplative practice, because the activity perpetuates an illusion of coherence. Focusing on past events or possible future outcomes is regarded as a symptom of "craving" or "attachment," which in turn is regarded as a core feature of human suffering, called dukkha in contemplative practice (Kabat-Zinn, 2014b, 2016).

Contemplative Practice and Mind Wandering

Contemplative practice is an umbrella term referring to several types of methods and theories involving meditation. Meditation itself can mean many things, but most commonly, it refers to practices based on Buddhist teachings.

Contemplative practice typically assumes certain facts regarding the world. These are derived from Buddhist practice and state that life is full of suffering, or rather dissatisfaction (Duhkha). Suffering includes everything from simple irritation and disappointment to the sorrows of losing loved ones. Dissatisfaction relates to how we are motivated to perpetuate pleasant experiences. The world is ever-changing; there is no escaping growing old or becoming sick. The value of your belongings will change and even mountains will eventually erode. Your interests and hobbies will change. When was the last time you picked up a favorite childhood toy, for instance, or redecorated your home? The worlds, both inner and outer, are in constant flux, changing moment by moment. This dynamic of change confronts us with the fact that our present experiences will not last. We try to counteract the changing dynamic of the world by seeking to perpetuate pleasant experiences, thereby acting on a feeling of dissatisfaction with the ever-changing nature of the world. One of the causes of this dissatisfaction (Duhkha-samudaya) is attachment, or craving of pleasant experience (Aich, 2013; Kabat-Zinn, 2016; Li & Ramirez, 2017, p. 172; Rosch, 2015).

Our experience of the world is usually accompanied by thoughts and feelings and mind wandering. We label and categorize these experiences (Didriksen, 2018) as good or bad, right or wrong, pleasant or unpleasant. We let the mind wander to future scenarios, or past choices: “if I had only done so and so,” “next time I will do this or that.” Such mind wandering gives rise to craving by creating impulses that motivate us to maintain the positively labeled experiences and end, or avoid, the negatively labeled ones (Didriksen, 2018; Masuda & Sargent, 2017, p. 201). The mind wanders to scenarios where we are able to try out possible outcomes of imagined actions, “If I won the lottery I would so and so.” This is also known as attachment by contemplative practitioners (Aich, 2013). Attachment is something we encounter on a daily basis. We are attached to pleasant experiences; we do not want pleasant experiences to stop. The mind wanders to imagined scenarios where the pleasant experiences are perpetuated.

Soap bubbles, for instance, can be a tremendous source of joy for small children. The child may marvel at the bubbles’ ability to float in the air, but when the child tries to grab a bubble, the bubble bursts and often times the child will start to cry, which can often be, quickly, alleviated by more soap bubbles. The child is attached to the experience and does not want it to end, the attachment being a future- or past-oriented figment, or mental construct, that the mind wanders between, i.e., remembering the bubbles and the associated sensations, the craving for that experience to be present, and the mind wandering to the prospective futures that accommodate this.

We attempt to maintain pleasant experience and worry that the experience will end. We worry, and the mind wanders to a scenario where we will lose our job, our

money, our status, and our youth. This leads to a wish for things to be different than they are – a wish for things to be static and stable. This worry is often involuntary and something that tends to happen at inconvenient times, when other things, such as a job, or relationship, or academic performance, need attention, i.e., the mind wanders away from the task at hand.

Contemplative practice assumes that nothing is permanent. The soap bubbles will end, the ice cream will melt, you will grow old, etc. Attachment to these impermanent experiences, e.g., the joy of the soap bubbles, the ice cream, youth, leads to a wish, or craving, for the experiences to be different, for the impermanent to be permanent. This leads to frustration or dissatisfaction (Li & Ramirez, 2017, p. 172; Ostafin, 2015) because the world we inhabit does change. A new routine at work, a new boss, a pay cut, or a job not living up to our expectations are close to inevitable and may prompt a wish for things to be different, thinking the grass is greener elsewhere. This thinking, or craving, that things need to be different points towards an imagined scenario that the mind wanders to: what would it be like if I had more money, or my boss appreciated me more, perhaps I should take a vacation, buy a new car, and the mind wanders on and on.

Attachment to pleasant experiences arises from internally constructed desires, goals, and thoughts about how the world is and should be. This is also true for who we think we are, i.e., the self-narrative (Capps et al., 1997; Kabat-Zinn, 2014b).

When you are reading this, your mind may already be filing in the gaps. You may think "oh, that is nonsense" or "that makes sense." Perhaps you even became aware that your attention had lapsed into a narrative. In other words, your mind wandered and in doing so created an illusion or a constructed figment. This idle thought process, the attention drifting toward constructed or imagined narratives, is the wandering mind. This mind wandering is a source of dissatisfaction (Hazlett-Stevens, 2017; Kabat-Zinn, 2016; Li & Ramirez, 2017, p. 264) and negative affect (Killingsworth & Gilbert, n.d.).

Thoughts gravitate to prospective futures, or self-narratives; perhaps you skipped the text and read only the abstract before jumping to the conclusion, saying to yourself "I'm a Ph.D. I will fill in the rest." This is a cause for suffering, according to contemplative practice. We are unsatisfied, always preparing for the next moment and the next paper, the next conference or lecture. This leaves us, to a large extent, with a great deal of our lives lived in a constructed reality (Killingsworth & Gilbert, n.d.; Smallwood & Andrews-Hanna, 2013). Even the self that we are clinging to, or the narrative of the self, the idea that there is a coherent self across time, makes us biased. We integrate experience into our narrative, and while doing so, we favor integration of events and experience that fit well with the established story or narrative of who we are and reject aspects of the experience that do not (Capps et al., 1997; McAdams, 2001). When a task becomes routine, we engaged in task-unrelated thoughts, i.e., mind wandering, and divert attentional resources and awareness away from the waking moment (Campbell et al., 2012; Smallwood et al., 2008; Tang et al., 2007) in favor of integrating the experience into our narrative.

According to contemplative practice, the only way to stop suffering (Duhkhanirodha) is to end the cause of suffering, i.e., craving or attachment (Kabat-Zinn,

2016; Li & Ramirez, 2017; Rosch, 2015). This requires identifying what and when we become attached and how the associated behavior manifests itself.

There are many sayings regarding this in contemplative practice. One is the parable of the mind being like a lake reflecting the moon: The mind is like a lake. When we think, the lake becomes full of ripples and does not reflect the moon as it is; when the lake is calm, it will reflect the moon and world as it is. What is meant by this is that our notions of how things are supposed to be, or our wandering mind jumping from one theme to the next, clouds the mind and makes ripples in the lake. So, in order to end dissatisfaction, it is important to calm the mind and notice how and when it wanders and creates the ripples in the lake.

It is not that there is a perfect reflection or truth to be attained; rather it is a matter of seeing more of the detail by paying attention and calming the distractions, or ripples as it were. Mindfulness-based stress reduction (MBSR), an 8-week contemplative program aimed at reducing stress, starts out with what is called a raisin exercise. Participants in an MBSR class are asked to do an everyday, well-known (for most), activity: eating a raisin. The task is then to experience the smell and texture of the raisin, so you are more aware of the properties of the raisin. The experience of the properties is reflected more clearly, if not obscured by letting the mind wander or engaging in other activities that would otherwise create ripples that obscure the experience. By concentrating on the present moment experience of eating a raisin, thereby reducing the number of stray thoughts, the experience of a mundane everyday task, changes.

Zen, another contemplative practice, uses a term called shoshin, or the beginner's mind, to describe how preconceptions limit our responses. We believe we know what something is like, due to our experiences, which are founded on memories. The beginner's mind is open and present; the expert's mind is full of pre-conceived notions of how thing are or should be (Hazlett-Stevens, 2017; Suzuki, 1973). These pre-conceived notions often happen without us noticing, leaving few possibilities. While reading this chapter, you may have thought something in the lines of "I wrote something just like this once" or "this is nonsense, I know of research that proves or disproves this and that statement." Before long, an internal narrative is unfolding, integrating, and relating what you are reading with what you remember from your own experience. You may even start to label parts of the text affectively as good or bad, depending on your views and opinions. This affective labeling will limit and guide future actions and perception. The beginner will have few such reservations.

A way to promote shoshin is to engage in contemplative practices such as Zen meditation or mindfulness training (Rosch, 2008; Suzuki, 1973).

Mindfulness

Mindfulness is a core element of several different contemplative practices. As such it can be found in Tibetan Buddhism and in Zen Buddhism and even yoga (Kabat-Zinn, 2015; Kirmayer, 2015). The concept of mindfulness can be problematic

because it is a multifactorial concept (Bishop et al., 2006) and is often operationalized differently from article to article. However, the key factors are typically defined as awareness and attention (Brown & Ryan, 2003).

In the west, the word mindfulness is typically synonymous with two distinct clinical programs: mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT). Both are empirically and clinically validated programs used to treat stress and recurring depression (Young et al., 2018). In clinical programs, and academia, mindfulness is usually defined, or operationalized, as:

> "Paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 2013; Rogers et al., 2018; Xu et al., 2017).

Jon Kabat Zinn spent a great deal of time with Zen teachers, engaging in contemplative practice (Kabat-Zinn, 2014a) and based a program, called mindfulness-based stress reduction, on secular aspects of what he had learned. Jon Kabat Zinn is a PhD in molecular biology and professor emeritus at Massachusetts medical school where he founded the center for mindfulness, where he and his team continue to develop and teach the MBSR program (Marchand, 2012).

MBSR is based on elements from Zen and Tibetan Buddhism along with yoga. MBSR is an 8-week-long, group-based program with weekly meetings with a trained instructor and individual home practice every day (Kabat-Zinn, 2013).

MBCT was developed in the United Kingdom by Zindel V. Segal, Mark G. Williams, and John D. Teasdale and is based on the same 8-week structure as MBSR. MBCT also includes elements of cognitive therapy (Troy et al., 2013). It revolves around providing a meta-awareness of when rumination takes place and aims at enabling the practitioner to step back and observe, non-judgmentally, how rumination and self-devaluating thoughts arise and fall away (Segal et al., 2012). The results of MBCT have shown a reduction in depression relapse, from 70% to 39%, and an extension of the interval between episodes by up to 18 weeks (Williams et al., 2008). MBCT, like MBSR, teaches a meta-awareness that helps the practitioners catch signs of changes to their mental and physical well-being in time to reorient their response, so the practitioner does not engage in adverse mind wandering, i.e., rumination.

The aim of the clinical mindfulness programs is to practice and train attention on the present moment without engaging in the affective aftermath of thinking. When we engage in mind wandering, we may feel emotions that are accompanied by specific thoughts. For instance, losing a job may lead to thoughts of unfairness, because of all the work that was put into the job, leading to a feeling of frustration or even anger. This, in turn, will lead to further thoughts, and before long, the drive home has happened while engaged in mind wandering.

Both MBSR and MBCT include a practice called "open monitoring" where thoughts, feelings, and sensations serve as the object of focus. The focus is intentionally directed to the present, moment to moment awareness of the ongoing experience (Britton et al., 2018; Lutz et al., 2008). This is reminiscent of mind

wandering except for that fact that the process is intentional. Open monitoring relates to the non-judgmental part of the operationalization of mindfulness. Thoughts, feelings, and bodily sensations arise, and the practitioner is asked not to engage with these thoughts and feelings but simply notice how they arise. This can be difficult, because feelings are motivational. We strive to reduce unpleasant emotions and prolong and sustain pleasant emotions and experiences (Harvey, 2013; Holder, 2013).

When the mind drifts to unpleasant feelings, such as anxiety or rumination, it is natural to try to avoid these emotions, thereby becoming dissatisfied with the present situation that contains them.

Mindfulness-based interventions have been shown to mitigate depressive symptomology (Deng et al., 2014; Ramel et al., 2004). Mindfulness-based interventions have been effective in treating rumination (Campbell et al., 2012; Jain et al., 2007) and are proposed as the polar opposite of mind wandering (Mrazek et al., 2012). Mind wandering – task-unrelated thoughts – means inattention, and mindfulness promotes the exact opposite, namely, attention (Brown & Ryan, 2003).

Inattention causes the mind to wander (Andrews-Hanna et al., 2010). This takes place without us noticing but is a core factor in how we behave and make decisions and assign affective labels to experience good or bad, pleasant or unpleasant.

Mindfulness practice can address this by promoting meta-awareness. In mindfulness practice, specifically in open monitoring, the practitioner is taught to notice how thoughts, feelings, and sensations arise and fade. The practitioner is taught to mentally "step back" and observe the present moment experiences without engaging. Stepping back and noticing thoughts and feelings are required if thoughts and feelings are to be investigated further. If we do not notice the thoughts and feelings, they will guide us unconsciously (Rogers et al., 2018). The immediate thoughts and feelings that occur during mind wandering are biased toward our self-narrative that we mistake for objective truth.

Depressive disorder is a clinical and treatable disorder, often associated with mind wandering regarding one's own identity. In clinical depression, the self-view is distorted and reoccurring themes of self-derogatory thinking increase (Lou et al., 2019). People with depression often suffer from self-doubt, self-blame, and feelings of worthlessness and persistent rumination (Desrosiers et al., 2013; Smith & Alloy, 2009), in other words mind wandering. If the mind wandering component can be treated, the depressive symptoms may be reduced, by removing the tendency of mind wandering to prolong negative affective mental states, that again leads to more mind wandering in a reciprocal dynamic (Killingsworth & Gilbert, n.d.). A contemplative practice has already been established as a treatment method for depressive disorders in the form of mindfulness-based cognitive therapy (Marchand, 2012; Segal et al., 2012). The mindfulness component of the program may target the mind wandering aspect of the disorder and could potentially be a viable treatment option for psychiatric care of other patients.

Mind Wandering and Mindfulness in Psychiatric Care

Mindfulness reduces past- and future-oriented thoughts and mind wandering and reorients attention to the present moment (Xu et al., 2017).

Practicing mindfulness for 10 minutes prior to a task increases focus of attention to stimuli that is situated here and now and reduces internal narration among practitioners with clinical anxiety, indicating a possible explanation of mindfulness-based practice in treating rumination and worry (Robins et al., 2012).

Mindfulness reduces the frequency of reported mind wandering, when measured on the Mindful Attention Awareness Scale (MAAS), showing that mindfulness training is associated with reduced mind wandering (Fountain-Zaragoza et al., 2016). Mindfulness, when measured on the mindfulness attention and awareness scale, is even proposed as a potential opposite construct of mind wandering (Mrazek et al., 2012). MAAS is a self-report questionnaire, developed on the basis of factor analysis revealing the presence of two distinct factors, attention and awareness (Brown & Ryan, 2003; Campbell et al., 2012).

Mindfulness practice, or specifically attending to a singular stimulus, can be a possible method for reducing task-unrelated thoughts, i.e., mind wandering. This singular stimulus, such as the breath, or the present moment awareness of what is happening in the here and now, may anchor attention and prevent the mind from wandering off.

A practice where the attention is focused on an object, such as a mantra or the breath, is known as "focused attention" (Morrison & Jha, 2015), while focusing the attention on the experience as it is happening here and now is known as "open monitoring". Both are core elements of mindfulness practice (Kabat-Zinn, 2013; Segal et al., 2012).

It is also possible that contemplative practices, such as mindfulness practice, reduce mind wandering by providing an increased awareness of when mind wandering takes place and thereby allows for attention to be redirected from the task-unrelated thoughts more quickly. This is a core practice of MBSR, where practitioners are taught to become aware of when their mind has wandered off. Instead of engaging in affective activity, such as frustration that the mind has wandered, practitioners are instructed to return their attention to the chosen focus, i.e., the breath or the body (Kabat-Zinn, 2013). This is also the case for Zen practitioners, another form of contemplative practice. Disciplining the mind this way repeatedly will eventually cause changes to the structure of the brain and reduce mind wandering (Harding et al., 2004).

Unawareness of the present situation increases the likelihood of attentional drifting and shifting attention resources toward inner, self-referential processing while decreasing attention to the task at hand (Andrews-Hanna et al., 2010; Campbell et al., 2012; Goldin et al., 2009; Nejad et al., 2013; Northoff et al., 2006). Self-referential processing is the process of thinking of, remembering, or otherwise engaging in cognition relevant to the sense of self (Zhao et al., 2018). Self-referential processing is how we relate thoughts, memories, emotions, and experiences to the

sense of self. It is the story we tell ourselves of who we are, our self-narrative. (Nejad et al., 2013; Zhao et al., 2018).

Mind wandering comes at the cost of attention to the present moment experience of the here and now. During mind wandering, without intention, attention switches between ideas and thoughts with no apparent focus (Dust, 2015).

Contemplative practice such as mindfulness seems to counteract the effects of mind wandering, by focusing on the here and now, present moment. This has been measured on self-report scales (Baer et al., 2006; Im, 2017) and corroborated through scans of brain structures associated with mind wandering (Andrews-Hanna et al., 2010, 2014; Mason et al., 2007) and a sense of self (Andrews-Hanna et al., 2010; Buckner et al., 2008; Davey & Harrison, 2018).

Integration of our experiences from the past and our thoughts of prospective futures into a coherent story plays a central role in identity or self (McAdams, 2001). We spend a considerable amount of time generating a coherent narrative of the self when the mind wanders (Carmody, 2015; Ostafin et al., 2015), by exploring possible outcomes and reconstructing past events in order for them to fit in with our self-view (Baird et al., 2011; Davey et al., 2016; Davey & Harrison, 2018; McAdams, 2001; Wagoner, 2013).

All these effects of mind wandering share a common theme: they are constructs of temporally disjointed elements, ranging from reconstructed or biased memories of past events to imagined futures. In fact, mind wandering is, per definition, situated anywhere but in the present moment.

So, what happens to the self-narrative when we engage in contemplative practices that seem to reduce key mental mechanism of this narrative? To answer that, we need to look at how the mental self-construct might look.

Self-Construct

Mental time travel, in the form of mind wandering, is associated with memory: rethinking past experiences and imagining possible futures. These mental processes, and the mental constructions of past and prospective scenarios, are woven into a temporally coherent sense of self. Mind wandering plays a large role in the construction of the self-narrative by allowing goals to be refined and future scenarios to be prospected (McAdams, 2001; Medea et al., 2018; Smallwood & Andrews-Hanna, 2013).

Approximately half of our time is spent on mind wandering engaged in mental time travel, oriented toward the future or the past. During mind wandering, we engage in mental pursuits of future goals (Andrews-Hanna et al., 2010; Baird et al., 2011; Smallwood et al., 2009a, b, 2013; Smallwood & O'Connor, 2011; Song & Wang, 2012; Stawarczyk et al., 2011), or we ruminate about the past (de Dias Silva et al., 2018; Whisman et al., 2020). We spend time reliving and reconstructing past experiences (Wilson & Ross, 2003), creating a narrative that we integrate into the story of who we are (Capps et al., 1997) and thereby create a sense of self.

Mind wandering diverts attentional resources away from the present moment experience in favor of the past or an imagined future (Ramel et al., 2004; Smallwood & O'Connor, 2011; Spreng & Levine, 2006). The purpose of this mental time travel implies agency at its core. The story we create when remembering serves to form identity (Bluck & Alea, 2002; Capps et al., 1997; Markowitsch & Staniloiu, 2011; Prebble et al., 2013; Spreng & Levine, 2006; Wilson & Ross, 2003).

Memory of the events of one's own life are known as autobiographical memory (Prebble et al., 2013). Autobiographical memory is of personal significance and plays an important role in the construction of personal identity. Autobiographical memory spans a great length of time and provides the themes of one's life story (Bluck & Alea, 2002).

Memory and identity are intertwined. Memories, goals, and beliefs influence not only what is remembered but how the self is viewed. How the self is viewed influenced what is recollected about personally relevant memories and past experiences. This indicates a reciprocal role of the self and memory. The self is continuously recreated and functions as a way of creating a coherent sense of self across time (Wilson & Ross, 2003).

"Autobiographical remembering revolves around thinking about the past while being present in the here and now" (Bluck & Alea, 2002). As such, the continuity of the self is an emphasized function of autobiographical memory. Having knowledge of the past self promotes a continuity of the self. This knowledge preserves the sense of being a coherent self across time. Autobiographical memory also allows us to sample past events in order to retrieve information and thereby predict future events (Bluck & Alea, 2002). This is also what happens during mind wandering.

The autobiographical function of sampling the past and planning possible future outcomes (Bluck & Alea, 2002) is also a core function of mind wandering, indicating that a function of mind wandering may be to mentally try out possible outcomes of simulated future scenarios (Smallwood et al., 2011). Mind wandering serves to anticipate personally relevant future goals (Baird et al., 2011; Markowitsch & Staniloiu, 2011). Future-oriented mind wandering therefore involves more personally relevant thoughts that are part of structured sequences (Stawarczyk et al., 2013), which indicates that mind wandering may contribute to autobiographical planning and self-narrative.

The self-narrative is connected by memory. Memory connects distinct experience into a cohesive entity. Without it, the self would fragment and, instead of being one concept, it would break into singular, distinct experiences (Markowitsch & Staniloiu, 2011).

Mind wandering, in the form of mental time travel to the past and prospective futures, provides a sense of self-identity and continuity across time (Prebble et al., 2013; Tulving, 1985). Additionally, both prospective and past-oriented thoughts are often brought into context of the immediate focus (Andrews-Hanna et al., 2010; Spreng & Levine, 2006), indicating that this kind of mental activity consolidates experiences into long-term memory (Andrews-Hanna, 2012; Wamsley & Stickgold, 2010) while integrating memories and prospective futures (Smallwood &

Andrews-Hanna, 2013), in essence, creating a life story or narrative identity (McAdams, 2001, 2018).

This narrative identity, or story of the self, becomes of further interest to contemplative practices because it centers around who we are. The self-construct is something most of us hold on to with great attachment (Kabat-Zinn, 2014b). This idea is supported in the field of narrative psychology, where the self-narrative of who we are can perpetuate a disorder like agoraphobia (Capps et al., 1997).

We continuously identify and categorize ourselves as different, similar, or same as others (Bamberg, 2011, p. 204f), thereby categorizing the self and bringing it into a social psychological domain. Categorizing helps to construct a world view. However, we often mistake the mental categorization for the actual phenomenon (Kabat-Zinn, 2014a). This categorization sometimes places us in a double bind that can challenge our identity (Didriksen, 2018). Dukkha becomes clear when we spend time ruminating over dilemmas; it can produce a sense of dissonance – two or more cognitive beliefs that are in opposition and cause an unpleasant sensation, wherein these cognitive beliefs are mental constructions that produce a sense of frustration (Festinger, 1957). Cognitive dissonance, or a double bind can motivate an action of letting go or giving up but by realizing that the two held beliefs are simply constructions or conceptualizations, or narrative (Didriksen, 2018; Heine & Wright, 2017; Suzuki, 1973). These instances, where the narrative stops, and you give up trying to reconcile conceptualizations of the world in favor of becoming fully present to the experience in the here and now are regarded as waking up in contemplative practice (Kabat-Zinn, 2014a; Okumura, 2017; Suzuki, 1973).

The default mode network, a set of anatomically distinct regions active when we are idle and generating a self-narrative (Andrews-Hanna, 2012; Andrews-Hanna et al., 2010; Buckner et al., 2008; Davey et al., 2016; Davey & Harrison, 2018; Mason et al., 2007), are downregulated by contemplative practice (Garrison et al., 2015) suggesting that the self-referential process, or self-narrative, is reduced by contemplative practice.

The Mind and the Brain

Brain morphology related to mindfulness meditation suggests a reduction in self-referential processing during contemplative practice and permanently reduced in experience meditators (Brefczynski-Lewis et al., 2007; Fountain-Zaragoza et al., 2016; Nejad et al., 2013).

As with the human body, the human brain adapts to its circumstances. This is called activity-dependent neuroplasticity (Barnhofer, 2019; Hölzel et al., 2011). We get good at what we do repeatedly (Harding et al., 2004). Lifting a weight repeatedly will promote muscle growth. Mind wandering repeatedly will do the same for our brains. In essence, we get good at attentional drifting. Engaging in contemplative practice, the contemplative practitioner is taught to focus on the present moment, and when the mind inevitably wanders, you are taught to bring the attention back

the present moment without engaging in the associated frustration, or other affective consequences. Doing so repeatedly will lead to changes in the brain. Due to activity-dependent neural plasticity, contemplative practice, when practiced regularly, makes it easier to retain attention and disengage from ruminating thoughts and promotes increased in gray matter in the prefrontal cortex (Hölzel et al., 2011).

fMRI scans show greater activation of specific, anatomically defined brain systems, called the default mode network, during mind wandering (Andrews-Hanna et al., 2014). Activity in the default mode network is synonymous with the narrative self (Andrews-Hanna, 2012; Davey et al., 2016; Davey & Harrison, 2018).

Mindfulness training reduces activation in the default mode network in both long-term meditators and novice practitioners with 2 weeks of practice (Brefczynski-Lewis et al., 2007; Tang et al., 2007).

Increased default mode network activity is seen during the rumination of patients with clinical depression (Connolly et al., 2013), indicating a possible role of rumination in the reconstruction of a self-narrative.

The default network is especially active during passive epochs or resting states allowing possible outcomes of action to be constructed in the imagination and to "consolidate past experience in ways that are adaptive for our future needs" (Buckner et al., 2008; Davey et al., 2016; Davey & Harrison, 2018). However, this mental time travel means we are paying attention to something that has not happened yet, or something that has already happened and not paying attention to the here and now (Andrews-Hanna, 2012). This is essential to the contemplative practice.

Mind wandering is also related to self-monitoring, as indicated by increased activation in ventral regions of prefrontal cortex as mind wandering increases (Allen, 2013; Andrews-Hanna et al., 2014; Davey et al., 2016).

This process of self-reference has been the subject of many neurobiological experiments showing activation in particular regions (the medial prefrontal cortex (MPFC), posterior cingulate cortex (PCC), and inferior parietal lobule (Davey et al., 2016)) of the default mode network (Nejad et al., 2013). The default mode network plays in integral role in self-referencing, and even the sense of self, by integrating past experiences and prospecting future scenarios (Davey et al., 2016).

The default mode network is always engaged in activity, even when there is no apparent task or purpose, when we are simply at rest. This is why it is called the default mode network. It is the default state of activity in the brain, when we are idle and not engaged in goal-oriented tasks.

Goal-directed tasks, such as attention, learning, or memory, however, reduce activity in the default mode network. Data suggest that the default mode network competes for cognitive resources with brain regions supporting attention control, memory, and analytical reasoning (Tang, 2017).

The default network has been shown to increase in activity during self-referential processing, indicating the default mode network as a biomarker for the internal self-narrative.

Increased activity in the default mode network is correlated with major depressive disorder, indicating the role of the self-narrative or self-referential process in major depression (Buckner et al., 2008; Dust, 2015; Nejad et al., 2013). Increased

activity in the default mode network is also a possible risk factor for developing depression (Whisman et al., 2020). Having a possible biomarker for the self-narrative means it is possible to gage narrative activity with the help of tools such as electro-encephalogram, meaning that contemplative practice is not only measurable by qualitative means but also by quantitative data, strengthening the results that indicate that reducing mind wandering, in favor of a present moment awareness, may promote a host of benefits.

Discussion

Mind wandering has a neurological correlated in the default mode network that increase in activity when we are idle. Increase frequency of mind wandering has been correlated with increase in negative mood and depressive symptoms (Deng et al., 2014; Ramel et al., 2004).

Sorrow, lamentation, grief, and rumination are regarded as suffering. Sorrow evokes thoughts and emotions regarding the past. Grief, too, is a wish for something to be different and revolves around past events (Harvey, 1990). Grief promotes thoughts of how things were and what was lost. Rumination is an ongoing temporal departure from what is going on in the here and now.

Minder wandering is inherently situated in the past or in the future and feeds the sense of self by trying out scenarios and recollecting the past.

Mind wandering enables a sense of a coherent self across time. When we are idle, we generate a narrative of who we are and integrate thoughts, feelings (Pawle, 1995; McAdams, 2018; Smallwood et al., 2011), memories (Bluck & Alea, 2002; Markowitsch & Staniloiu, 2011; Wilson & Ross, 2003), etc. into this narrative of the self.

To the contemplative practitioner, there is no permanent self (Davis, 2014; Heine & Wright, 2017; Pawle, 1995), and it is the clinging to this idea of who we are, that, in part, gives rise to suffering or dissatisfaction (Dunne, 2015).

If a loved one leaves us, we may feel despair, because we wanted the relationship to last. When someone else gets promoted, we may feel overlooked or even jealous. If we suffer from clinical depression, much of our time is spent ruminating (de Dias Silva et al., 2018; Whisman et al., 2020), and this rumination is the target of much conventional psychotherapy. In the World Health Organization manual, international statistical classification of diseases (ICD 11), “prolonged grief” is suggested as a mental disorder characterized by “longing for the deceased or a persistent preoccupation with the deceased accompanied by intense emotional pain” (WHO ICD 11).

If we suffer from clinical anxiety, much of our time is spent worrying or imagining worst-case scenarios (Hofmann et al., 2010; Segerstrom et al., 2000), taking attention away from life here and now. Over time this can cause a loss of functionality, for example, an inability to engage socially, to buy groceries, etc. Treating this condition often revolves around correcting the ongoing involuntary catastrophic

thoughts through cognitive behavioral therapy and Socratic dialogue, or by challenging the narrative brought on by identifying with the catastrophic thoughts (Capps et al., 1997).

Much of our perception is biased and based not so much on objective measures of the world but on our interpretation. This interpretation is a product of culture, memories, and values and rarely has much to do with the sensory perception of the object at hand. This goes even deeper, because at the core of contemplative practice is the notion that the self is a construct; peel away the layers and there is no permanent self to find.

Why Is this Important to the Subject of Mind Wandering?

Mind wandering and activity in the default mode network have been established as a seat of narrative identity (Andrews-Hanna et al., 2014). The association between self-reference (Davey et al., 2016; Nejad et al., 2013), memory (Markowitsch & Staniloiu, 2011; Prebble et al., 2013), and the default mode network as a center of gravity of the self (Davey & Harrison, 2018) indicates that mind wandering serves a role in the sense of self.

The self is a highly motivational concept. We are at a loss when the self is threatened. We seem to cling to notions we identify with. This clinging often creates a feeling of dissatisfaction, preparing or worrying about the future, because we don't want a present state to end. When we are finishing a project or an exam, we are already worrying about the outcome or planning the next exam. To the contemplative practitioner, everything is impermanent, and the craving for the world to stay permanent is one of the reasons we suffer.

This is exactly what is being taught at the mindfulness-based stress reduction programs (Kabat-Zinn, 2013; Segal et al., 2012). Students are taught to disengage from mind wandering and return their attention to a present moment anchor of focus, usually the breath. When participants start this program, they find that their mind wanders off. Students are then taught to realize that their mind has wandered off and then return to the current situation. Doing so, over and over, engages activity-dependent neural plasticity that in turn makes it easier to pay attention to the present moment.

To begin with, students of MBSR, and many other contemplative practices, are taught to focus on the breath and the body. However, the present moment includes more than just the breath. To reformulate an example (Rogers et al., 2018), while you have been reading this chapter, it is likely that you got distracted, perhaps by the creaking of floor board or the chattering of others, perhaps physical sensations, such as hunger that sparked thoughts of enjoyable foods. You may have noticed that parts of this chapter have sparked your own ideas. You may disagree with some of the theories and start to formulate a response, and you may even find mistakes that elicit an emotional response. Perhaps you consulted the reference list to learn more about a topic. In other words, your mind wandered and your attention went elsewhere. You

may not have noticed these instances when you shifted your attention away from the chapter, or you may have and even brought your attention back. But, did you notice all the other small things that happened? Are you currently sitting in the same posture you did when you began reading? If not, when did it change?

Contemplative practice, such as mindfulness practice, strengthens our ability to notice that the mind has wandered away from the object of attention, e.g., this article, but contemplative practice does not ignore stimuli or try to obscure the world around us. On the contrary, by engaging in contemplative practice, the contemplative practitioner strengthens the ability to, deliberately, redirect the attention back to the present moment and not be caught unaware by the wandering mind.

As soon as a task becomes routine, we engaged in task-unrelated thoughts, i.e., mind wandering, and divert attentional resources and awareness away from the waking moment. By continually engaging in contemplative practice, the practitioner is able to reduces distraction and increase the ability to sustain attention over time. Contemplative practice, when repeated over time, changes brain structures due to activity-dependent neuroplasticity (Harding et al., 2004). This means that the neural substrate of the contemplative activity is strengthened and thus becomes easier and less resource demanding, resulting in less mind wandering (Brefczynski-Lewis et al., 2007; Harding et al., 2004).

When people are stressed, depressed, or anxious, mind wandering has been found to take a turn for the worse (Deng et al., 2014). When this happens, certain themes can be identified during mind wandering. In depression these themes can be self-derogatory, and in anxiety they are future oriented in the form of worry or catastrophizing (Segerstrom et al., 2000) that can hinder the life of the person (Capps et al., 1997).

Even the concept of the "self-narrative," the idea that there is a coherent self across time that we often cling to, can be problematic if patients who are depressed or anxious start identifying with the disorder and integrate it into the narrative of who they are (Capps et al., 1997). Even without a disorder, the self-narrative obscures what we experience. We sort stimuli and integrate what we find meaningful to our story into our narrative, thereby sorting and discarding much information that could otherwise prove useful (Baird et al., 2011; Davey et al., 2016; Davey & Harrison, 2018; McAdams, 2001; Nejad et al., 2013; Stawarczyk et al., 2011; Wagoner, 2013).

Mind wandering is essential to the self-narrative, by self-referencing and contextualizing present moments and comparing them to past events and even other memories. This is something that we spend a great deal of time doing while idle, which plays a part in who we think we are.

What would happen to this "narrative self" when we engage in contemplative practice that seemingly opposes mind wandering?

To the contemplative practitioner, who we are is not who we *think* we are. The narrative self we seem to continuously create and recreate when we let the mind wander (Andrews-Hanna et al., 2014; Prebble et al., 2013; Smallwood et al., 2011) is regarded as an illusion that perpetuates our dissatisfaction or dukkha. Zen practitioners, another form of contemplative practice, often refer to the self with no

narrative as the no-self, or Mushin, the empty self (Pawle, 1995; Suzuki, 1973). By reducing the self-narrative, we do not negate the self. This can be difficult to comprehend because of the cultural significance of Aristotelian logic where something is either A or Not-A. To the contemplative practitioner, things can be "both and" rather than "either or." Abandoning the duality of the self and the "narrative of the self" is essential in contemplative practice (Didriksen, 2018; Dunne, 2015; Li & Ramirez, 2017; Pawle, 1995).

The story we tell ourselves of who we are, the self-narrative, can hinder us. This is often the case with some instances of anxiety (Capps et al., 1997). By engaging in contemplative practice, this narrative story becomes quiet. Activity in the default mode network of the brain is reduced (Davey et al., 2016; Mason et al., 2007; Morrison et al., 2014; Rahl et al., 2017; Young et al., 2018). The constant orientation toward future pleasures, the next raise, the next vacation, or rumination, about the past is reduced. This offers the opportunity to wake up from autopilot and engaged with life as it is, here and now. When the mind quiets down, the sense of self that emerges is quite different from the notions that we are habitually attached to (Davis, 2014; Pawle, 1995; Suzuki, 1973).

Waking up indicates being asleep, unaware, before you become aware. Mind wandering is regarded in this manner, from the contemplative point of view, as lapses in concentration and awareness of the present moment.

Not all mind wandering is bad. It is the unawareness of what is going on in the here and now that is the root of suffering. Once you realize that dissatisfaction is what causes day-to-day suffering, or dukkha (Kabat-Zinn, 2016), you will be able to disengage from the automatic, unaware mode of being and begin intentionally observing how your thoughts, feelings, and present moment sensations play out in the here and now.

This also opens the possibility for mind wandering without engaging in mindless, unaware mind wandering.

Mind wandering has been proposed as the opposite of mindfulness (Mrazek et al., 2012), a deficit in attentional control (Kane & McVay, 2012), but new research also suggest that mind wandering may serve to enhance creativity (Mooneyham & Schooler, 2013). To the contemplative practitioner, the key factor is being aware that your mind drifted or that much of life is lived on auto pilot (Desrosiers et al., 2013; Robins et al., 2012). At the same time, a core teaching is to be aware of what is going on in the here and now and not be swept away by the currents of emotion and thoughts (Dunne, 2015; Kabat-Zinn, 2014a, 2015; Li & Ramirez, 2017; Suzuki, 1973).

So, what if what is going on in the here and now is mind wandering?

The answer would seem to be both complicated and rather novel.

It has been speculated that mind wandering is not, in fact, the core factor in psychological distress. Rather, the absence of present-moment awareness may be the factor that causes the distress (Stawarczyk et al., 2012; Xu et al., 2017). This opens op the possibility for a compromise.

New research tries to make the distinction between intentional and unintentional mind wandering (Seli et al., 2016).

Intentional mind wandering would require a meta-awareness that your mind is wandering, without judgment or intent to stop the process, which would be would be in line with contemplative practice. Because mind wandering *is* what is happening here and now, it can serve as the object of focus. This requires a meta-awareness, which is what meditation and mindfulness practice provides (Raffone et al., 2019).

Mind wandering serves as a possible framework for the narrative self-identity. Narrative psychology and neuropsychology, with the help of brain scans, have confirmed activity in the default mode network and related it to self-referencing and a narrative of who we are.

This narrative can reinforce mental disorders, such as anxiety and depression, for example, when an ongoing self-narrative becomes reinforcing for the identity of someone with anxiety (Capps et al., 1997), or when ruminations on themes of self-blame and a derogatory self-narrative, become symptoms of depression (Deng et al., 2014; Hofmann et al., 2010; McLaughlin & Nolen-Hoeksema, 2011; Nejad et al., 2013).

Typically, clinical anxiety and depression have been treated in psychiatric sessions, possibly using cognitive behavioral therapy in an attempt to correct the patterns of thinking that sustain the clinical disorder.

New forms of treatment based on contemplative practices, in the form of MBSR or MBCT, have shown great efficiency in alleviating mental disorders by treating the wandering mind when it becomes problematic. This has been measured both on self-report scales and on biomarkers retrieved from EEG and fMRI scans (Young et al., 2018).

Conclusion

At the core of contemplative practice is the reduction of self-narratives and the accompanying thoughts oriented toward past or future experiences, along with the reduction of the associated emotions. Contemplative practice is a training in paying attention to the present moment. A by-product is that reducing mind wandering, and thoughts about the past or the future, has been shown to reduce stress, anxiety, and depression. Reducing thoughts about the future and the past also affects the construct of the self. Contemplative practice allows the self to step out from the shadow of its own narrative. The self-narrative can perpetuate disadvantageous states of mind and oftentimes promotes an attachment to the way things are, leading to dukkha, or dissatisfaction.

To reduce mental time travel, one simply needs to be aware of the here and now, the present moment, when the mind wanders. The training consists of noticing this and bringing the attention back to the present moment over and over.

As Jon Kabat-Zinn puts it: paying attention on purpose and nonjudgmentally (Kabat-Zinn, 2013).

At the heart of contemplative practice is the taming of the wandering mind, or the "monkey mind" (Bartok & Roemer, 2017). Repeated practice reduces mind wandering

and the simple practice of meditating regularly has significant, lasting effects on attention and even clinical disorders. Contemplative practice, such as Zen and mindfulness, promotes lasting changes to the brain (Hölzel et al., 2011; Raffone et al., 2019; Young et al., 2018) and promotes cognitive performance (Zanesco et al., 2018).

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Chapter 11
Mind-Wandering and Emotional Processing in Nondirective Meditation

Halvor Eifring

The discovery of the brain's default mode network (Raichle et al., 2001) and its link to "stimulus-independent thought" (Mason et al., 2007) has brought about a large amount of research on the wandering mind (Christoff et al., 2016; Smallwood & Schooler, 2015). Initially, this research most often saw mind wandering as a negative force, distractive and destructive, linked to rumination and depression, and some claimed that "a wandering mind is an unhappy mind" (Killingsworth & Gilbert, 2010). It was argued that mind wandering leads to excessive concerns with past troubles and future worries, leading attention away from the present moment. In light of this, research on mindfulness and other forms of meditation often argued that meditating could bring the practitioner back to the present moment (Taylor et al., 2013) and reduce the amount of mind wandering and default mode network activity (Brewer et al., 2011). This view is represented in Didriksen's contribution to this volume.

Gradually, however, an emerging alternative view of mind wandering sees it as a universal phenomenon with important adaptive functions and argues that a wandering mind is not necessarily unhappier than a focused mind (Poerio et al., 2013). If mind wandering were only negative, it would hardly have survived millions of years of evolution and still be such a widespread trait in human beings. Mind wandering taps into our memory of the past and bolsters our ability to plan for the future (Christoff et al., 2011; Limb & Braun, 2008; von Hecker et al., 2013; von Hecker & Meiser, 2005). It helps us understand ourselves and empathize with others (Winters et al., 2021). It makes it easier to shift perspective flexibly and to think and work more creatively (Baird et al., 2012; Chrysikou et al., 2020). It also helps us relax, and the default mode network is therefore often also called the resting state network. The default mode network is exactly that: the *default* mode that applies whenever there is no specific task or stimulus that activates other parts of the brain (Sripada,

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2018). This network is also important in our experience of nature (Gould van Praag et al., 2017), in human communication (Xiao et al., 2021), and in the reading of literature (Fabry & Kukkonen, 2019). The resting brain may even provide the basic building blocks that make consciousness possible (Northoff, 2018). A small but important literature is beginning to emerge around what is sometimes called *nondirective meditation*, which is based on a free mental attitude (see below), and in which mind wandering and default mode network activity are not only accepted but actually stimulated (Davanger et al., 2010; Lagopoulos et al., 2009; Nesvold et al., 2012; Xu et al., 2014; Gutierrez et al., 2015; Solli, 2016; Eifring, 2016, 2019a; Hersoug et al., 2018, 2021; cf. also Solberg, 2004; Travis & Shear, 2010; Carrington et al., 1980; Naranjo, 1971; Paccione & Jacobsen, 2019).

In this chapter, we shall look at one specific function of mind wandering which is more rarely discussed in the research literature, but which turns out to be quite important: *emotional processing*. We have all experienced, perhaps without thinking much about it, how spontaneous thoughts of an unpleasant memory may gradually reduce the emotional tension associated with that memory, e.g., when the recollection of a quarrel at work spontaneously recurs again and again after returning home, until it gradually tapers off and loses some of its emotional charge.

An fMRI study of nondirective meditation suggests that by facilitating mind wandering, such techniques activate the default mode network and brain areas associated with memory retrieval and emotional processing (Xu et al., 2014). This chapter may be read as an attempt to further interpret, explicate, and put in context the results of that particular study, which we shall refer to as *the Xu study*.

Nondirective Meditation

A meditation technique is nondirective to the extent that it facilitates *mind wandering* in a wide sense of the term (Eifring et al., 2019). In this context, the term mind wandering refers to all spontaneous activity of the mind, including thoughts, images, emotions, sensations, and even some spontaneous bodily reactions, such as the natural breathing or involuntary movements – any activity that the meditator does not deliberately set in motion.

In addition to the spontaneous activity of mind wandering, any meditation technique also includes deliberate, voluntary activity. In nondirective meditation, the deliberate activity most often consists of the mental repetition of a meditation sound or a mantra with a free and open mental attitude, but it may also consist of an equally free and open attentional focus on the breath, body sensations, etc. One of the effects of this deliberate activity is to facilitate the spontaneous mental and bodily activities that are beyond conscious control.

The spontaneous activity may be *digressive*, as when the meditator forgets to repeat the sound or mantra and is temporarily lost in thought. This is the core meaning of the term mind wandering. However, it may also be *peripheral*, as when the deliberate repetition of the sound or mantra is accompanied by the coming and going of thoughts, usually in the periphery of the attentional field (Eifring, 2016).

Typical examples of nondirective meditation include Acem Meditation (Holen, 2016), Clinically Standardized Meditation (Carrington, 1978), Relaxation Response (Benson, 1975/2000), and Transcendental Meditation (Mahesh Yogi, 1963), as well as online teachings such as Natural Stress Relief (http://www.natural-stress-relief.com) and 1 Giant Mind (https://apps.apple.com/us/app/1-giant-mind-learn-meditation/id990931892). There are important differences between these methods (see Eifring, 2019b), but they also share a number of features.

An important element in nondirective meditation is the *free mental attitude* with which the technique is practiced. The free mental attitude is characterized by the following three features (cf. Holen & Eifring, 2013, pp. 18 f.):

1. Effortlessness of the practice itself, in most cases by repeating the meditation sound or mantra as gently as possible.
2. An open, wide-angled mode of attention, allowing the coming and going of spontaneous activity in the mind's periphery while the meditation object occupies the center.
3. Acceptance of the fact that digressive thoughts, feelings, images, and sensations sometimes take over the scene completely, so that the meditation object is temporarily forgotten, before one realizes this and gently returns to the meditation object.

These features are not separate but rather constitute three aspects of the same gentle, open, and accepting basic attitude. Without the basic acceptance of digressive mind wandering, an element of strain will replace the effortlessness of the practice, and without this effortlessness the mode of attention will become less open and wide-angled.

A number of studies have shown how meditating with a free mental attitude leads to different results than meditating with some degree of effort, self-observation, or concentration. This holds whether the meditation object is a sound (as in the Xu study; and in Davanger et al., 2010) or, e.g., the breath (Paccione & Jacobsen, 2019). In most cases, however, nondirective meditation is *sound-based*, which may be another factor, besides the free mental attitude, accounting for the deep relaxation such meditation brings about. Furthermore, there is a tendency to prefer *non-semantic* and *non-symbolic* sound combinations, in order to avoid steering the mind's spontaneous activity in pre-set ways (Eifring et al., 2019).

The Relaxation Response

Nondirective meditation differs from most mindfulness practices in emphasizing *relaxation* and *effortlessness* over attentiveness and self-observation (Eifring, 2019c). Much of the early research on meditation was linked to issues related to physiological relaxation (Wallace, 1970; Wallace et al., 1971), the relaxation response (Benson, 1975/2000), including oxygen consumption, lower blood pressure, reduced heart rate, slower brain waves, lower skin conductance, etc. This

research focused largely on nondirective meditation, in particular transcendental meditation, but also Herbert Benson's Relaxation Response and Patricia Carrington's Clinically Standardized Meditation. Later research on Acem Meditation has confirmed many of these early results (Lagopoulos et al., 2009; Solberg, 2004).

As research on the large panoply of mindfulness techniques took hold, the focus on relaxation has become less dominant. It is not clear whether that is because mindfulness techniques are less relaxing or just because the interest has moved on. Most likely, it is a combination of the two. Mindfulness techniques typically involve slightly more effort in taking care to observe the self, and this may reduce the degree of relaxation. Also, there is evidence that some mindfulness techniques require more effort than others, in other words, that they are less relaxing than others (Lumma et al., 2015). They typically involve a certain amount of concentration or self-observing effort.

At the same time, some of the more recent research on the relaxing effects of nondirective meditation has opened new arenas. For instance, a study of heart rate variability shows that the relaxation associated with nondirective meditation is a product both of the reduction of sympathetic activity and the increase of parasympathetic activity. Increased heart rate variability has become a new criterion for the relaxation response, along with other physiological criteria (Nesvold et al., 2012).

The Xu study can also be seen in this light. New neuroimaging techniques have supplied the traditional use of EEG to detect the relaxation response on a neural level. In particular, fMRI has helped to detect the activation of the default mode network during meditation. The intensity of this activation exceeds that of everyday, non-meditational mind wandering. This suggests that the degree of relaxation during meditation is significantly higher than during regular rest.

Two Types of Emotional Processing

As already mentioned, the Xu study also suggests that brain activity in centers associated with memory retrieval and, in our context most importantly, emotional processing goes markedly up during nondirective meditation.

What does "emotional processing" mean? In fact, both the Xu study and the literature at large employ this term in at least two quite different meanings, which are both relevant and which we shall see may be more closely related than a superficial look reveals. Our understanding of emotional processing hinges on the catch-all term "processing."

In one meaning, the term refers to *information processing*, i.e., the encoding, storage, and retrieval of information in the brain (cf. Sander, 2013). The brain or the mind is implicitly or explicitly compared to a computer that sends information back and forth between different centers or neurons. Successful information processing gives the various parts of the brain realistic and/or adaptive information input, while less successful information processing gives distorted and/or maladaptive information input. In this sense, "emotional processing" involves the transmission of neural

information regarding emotional experience from one part of the brain to another, e.g., from the amygdala to parts of the prefrontal cortex.

In another meaning, the term "processing" refers to *therapeutic processing*, i.e., the "working through" or "healing" of any kind of psychophysiological stress or disturbance, whether short-term everyday tensions, more severe trauma, or long-term maladaptive personality traits. In this meaning, emotional processing has been defined as "approaching, accepting, tolerating, symbolizing, making narrative sense of, and utilizing or transforming emotions" (Goldman & Greenberg, 2019, p. xi).

The Xu study points in both directions. On the one hand, it is concerned with the brain areas that are typically involved in the informational processing of emotions, such as the amygdala, the prefrontal cortex, the cingulate cortex, the hippocampus, and the basal ganglia. Its concern with memory retrieval also points in this direction. At the same time, the article discusses how nondirective meditation may "reduce stress by increasing awareness and acceptance of emotionally charged experiences," and this points to the therapeutic version of emotional processing.

The Mechanism Behind

Possibly, these two types of emotional processing should be seen as different aspects of one and the same process. The basic information processing of emotions could be seen as the neurobiological basis for the therapeutic modification of both short-term and long-term stressful emotional experiences. In this sense, the therapeutic modification of stressful emotional experiences could be seen as an extension and continuation of the basic information processing of emotional experiences.

In a simple computer model of the mind and the brain, one could hypothesize that the input of too much or too complex data may cause an overload, so the computer or the computer network crashes. In this way, some types of emotional experience may cause the mental processing system to deteriorate for longer or shorter periods, as in the case of everyday stress (short periods), rumination (often longer periods), trauma (long term), and formative childhood experiences (with possibly lifelong effects). This would result in cases of unsuccessful information processing, which gives distorted and maladaptive information input. When this is the result of formative experiences in childhood, it is likely to shape information input in systematic ways for the rest of one's life, unless one is at some point able to go through a therapeutic processing and modification of such formative emotional experiences, which might then have a healing effect on the basic mechanisms of information processing.

This model is only intended as a simple metaphor or analogy illustrating the possible connection between the informational and therapeutic processing of emotions. As such, the model is obviously in need of further refinement. For instance, it is not obvious that realistic and adaptive processing should be equated, and the same is true of unrealistic and nonadaptive processing. For instance, it has been argued that "unrealistic optimism" ("predictions made by people in a nonclinical sample [being]

more optimistic than is objectively warranted by the evidence") is an adaptive trait, while "depressive realism" (people with depression mak[ing] more accurate judgements and realistic predictions than people without depression") is less adaptive, although the nature of these phenomena is still up for discussion (Bortolotti & Antrobus, 2015). In the same vein, it is not obvious that the input of too much or too complex data actually leads the brain to "crash," even if it does react in ways that create problems or pain.

According to the Xu study, nondirective meditation leads to "significantly increased activity ... in [brain] areas associated with attention, mind wandering, retrieval of episodic memories, and emotional processing." On the basis of these findings, we could formulate a hypothesis about the causal mechanisms involved:

relaxed attention → mind wandering → episodic memories → emotional processing

One important feature of nondirective meditation is the *relaxed use of attention* involved in the free mental attitude, as implied by its effortlessness, its open and wide-angled nature, and its acceptance of digressions. This mode of attention facilitates an increased amount of *mind wandering*. This, in turn, creates opportunities for the retrieval of *episodic memories* that have been suppressed or relegated to the periphery of consciousness. Since these memories are often emotionally charged, their retrieval implies the resurfacing and *processing of emotions* that have not in the past been processed in a fully satisfactory way.

If this hypothesis is confirmed, the relaxed mode of attention associated with the free mental attitude plays a central role in initiating the entire process. It does so primarily by facilitating mind wandering, including not only the coming and going of thoughts but also of emotions and episodic memories.

In different studies, the *depth of emotional processing* in various forms of psychotherapy, as measured by the Experiencing Scale (Klein et al., 1986), has been associated with a sense of safety (Paulik et al., 2021), a decrease in overall anxiety (Harrington et al., 2018), and the nondirectiveness of the therapeutic approach (Borkovec & Costello, 1993). This gives some support to the assumption that the relaxed (= safe, non-anxious) and open (= nondirective) mode of attention that characterizes the free mental attitude is crucial for the activation of brain areas associated with emotional processing. The importance of a safe setting and a nondirective approach may be one of the reasons why most psychoanalysts emphasize the relaxed posture of the patient "on the couch" (cf. Lable et al., 2010). Kroth and Forrest (1969) link this preference of the couch to an assumption that relaxation reduces repression and increases free association. This is significant in our context, since free association resembles mind wandering in letting one association follow another freely and spontaneously. Both in psychoanalysis and nondirective meditation, this can be seen as a way of increasing the depth of emotional processing.

From Emotional to Structural Processing

How do the perspectives outlined above relate to the actual experience of practicing nondirective meditation? The answer to this question may help us to understand the role of emotional processing in nondirective meditation. The following discussion will not primarily be based on scientific studies but on my own experience as a teacher of Acem Meditation, supplemented by the accumulation of experiences of hundreds of Acem teachers and instructors over more than five decades.

For the majority of meditators, most meditation sessions are reported to be quite calm and not strongly emotional. The most common result of everyday meditations is the plain and well-documented physiological relaxation of muscles and the autonomic nervous system (slower breath, lower heart rate, etc.). This may provide a sense of relief and well-being, but not necessarily strong emotions, though some meditators occasionally report moderate feelings of anxiety, nervousness, sadness, or aggression in connection with the release of stress during daily meditations. At retreats with long meditations, accounts of emotional discharge during meditation sessions are slightly more frequent. However, such experiences are not typical, and to judge from self-reports, the most common experience of nondirective meditation is pleasant but emotionally fairly neutral, apart from the occasional restlessness and muscle aches that are sometimes part of the process.

In contrast to this calm and emotional neutrality, the guidance sessions that follow long meditations on Acem retreats are sometimes much more emotional. Even after emotionally neutral meditation sessions, the ensuing discussions of the meditation practice and the thoughts that pass through the mind during meditation sometimes bring out fairly strong emotions. These typically relate to the retrieval of memories linked to deep-seated personal issues from the recent or more distant past. Neither the emotions nor the memories involved have necessarily been overtly present during meditation itself but have nevertheless become more accessible to conscious cognition and are brought to awareness in post-meditation guidance.

We do not yet have a satisfactory neuroscientific explanation for the contrast between the emotional neutrality of meditation and the stronger emotionality of the ensuing guidance dialogues. From a psychological point of view, one possible answer is that emotions, while important, do not belong to the core of the personal issues involved but to their surface manifestations. In this line of thought, the underlying core is *structural* and may have emotional, cognitive, and behavioral manifestations (Beck et al., 2004; Sandell, 2019). If this is correct, the emotional processing discussed in the Xu study is a surface manifestation of underlying processes involving structural change. The emotional, cognitive, and behavioral manifestations of the issues involved only become accessible during guidance dialogues that take place in a social setting and involve the verbalization of impulses that may have been only latent during meditation.

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Chapter 12
The Secret Powers of a Wandering Mind: Underestimated Potential of a Resting State Network for Language Acquisition

Heiner Böttger and Deborah Költzsch

Introduction

Recent research on the human brain has changed from identifying specific brain regions and their contributions regarding mental processing to a focus on the networks of connectivity between regions with activity modes important and responsible for thinking and learning (Sporns et al., 2007). Thanks to this change in research, the underestimated potential of these brain networks has been discovered. Basic structures of such networks seem to be present from cradle to grave, developing especially until the age of 30 (Hoff et al., 2013). Thinking, feeling, or relating to other humans mainly strengthens and tunes these dynamic networks over a life span – partially depending on a person's environment, opportunities, and relationships. Communication and activity of neurons within and among the networks are increasingly balanced and stabilized through their growth (Sporns et al., 2004). A handful of major neural networks in the brain provide an insight into the essential dimensions of cognitive, emotional, and social processing, as well as their developmental interdependence.

The DMN Architecture: Within a Band of Neural Networks

Three of these major brain networks together support a broad range of mental capacities, the emotion network, the salience network, and the default mode network. They are inseparably and closely connected to each other, with the DMN itself being part of the other two networks. Through co-regulating and coordinating, these three networks contribute to social, emotional, and cognitive functioning,

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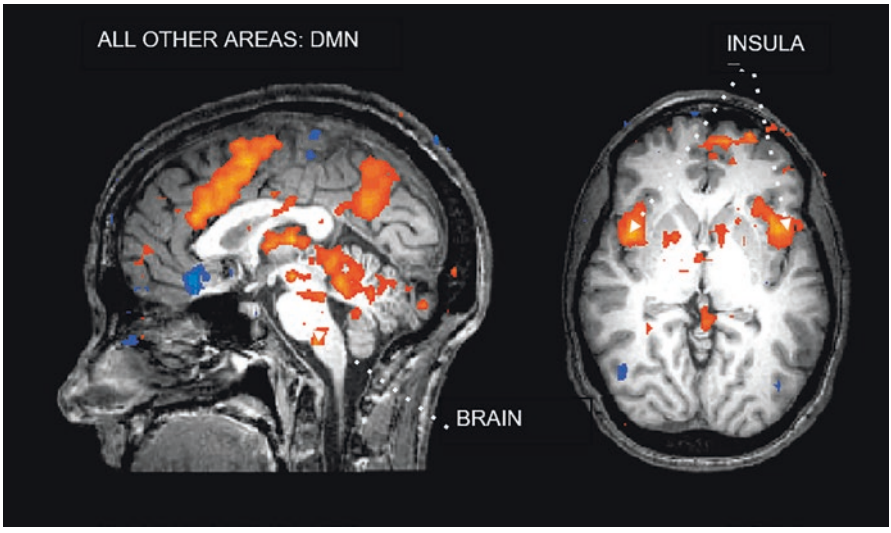
allowing humans to operate well in the world and to take advantage of learning opportunities. Extensive research connects the functioning of these networks to intelligence, memory, mental flexibility and creativity, mental health, capacities for emotion regulation and attention, and other essential abilities (Niendam et al., 2012). In children, adolescents, and across adulthood, the functioning of these networks correlates with the quality of one's environment, resources, and relationships (Chan et al., 2018) and improves with targeted intervention (Anguera et al., 2013). To varying degrees, these networks appear to be flexible across the life span (Tian & Ma, 2017).

The Emotion Network (EM)

The gray-faced regions in these fMRI (see Figs. 12.1 and 12.2) depict areas in the brain that were activated when individuals experienced strong emotions as they watched stories meant to inspire admiration and compassion. From a neural perspective, these graphics show how emotions are crucial to thinking and meaning-making. Among the regions of the brain showing heightened neural activity is the brain stem, which is involved in regulating breathing, heart rate, and other basic survival processes and is essential for consciousness. Furthermore, the right and left insulae, which sense the viscera and can be thought of as feeling emotion related, subjective or intuitive, are integrating these feelings with cognitive processes. All other marked regions are part of a network that is involved in processing



Figs. 12.1 and 12.2 The emotion network. (Data from: Immordino-Yang & Gotlieb, 2017)

psychological self, building coherent narratives, calling up personal memories, and thinking about beliefs and moral values – the default mode network. Coordinated activity across the insulae, which anchors the salience network and the default mode regions, is suggested to support reflective, emotionally relevant meaning-making.

The Salience Network (SN)

The salience network balances emotional relevance and perceived importance and urgency of information. This is to facilitate switching between mindsets supported by the inwardly focused, meaning-oriented default mode network and those supported by the outwardly focused, task-oriented executive control network (Goulden et al., 2014). Such a switching of mental modes reflects subjective, affective evaluation of external signals from the environment and internal bodily signals, such as from hunger and anxiety, by the salience network.

The Default Mode Network (DMN)

The default mode network is strongly engaged during all types of tasks that involve internally directed, interpretive, and reflective thought. These mental processes include remembering past experiences imagining hypothetical or future scenarios, or deliberating on inferred, abstract, or morally relevant information (Spreng & Grady, 2010) or daydreaming (Kucyi & Davis, 2014). The default mode network is mainly important for conceptual understanding, reading comprehension, creativity, nonlinear and out-of-the-box thinking (Beaty et al., 2016), feelings of inspiration, social emotions like compassion (Immordino-Yang et al., 2009), identity development (Supekar et al., 2010), and thinking about things that are not physically present (Tamir et al., 2016).

Raichle et al. (2001) first described the DMN. Its areas have six aspects in common:

- They need a lot of energy due to a high resting metabolism.
- They deactivate when an external task is executed.
- They exhibit decreased activation associated with many goal-oriented or attention-demanding tasks.
- They are counter-correlated with active networks.
- They provide a high functional and anatomical connectivity among themselves.
- They are highly spontaneously, automatically, and very quickly coherent when resting.

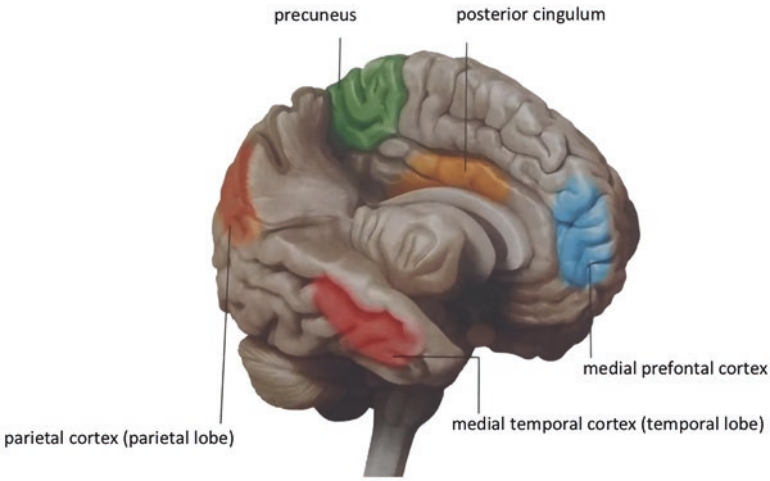


Fig. 12.3 Components of the default mode network. (Adapted and adjusted from Ricard et al., 2014)

– They include inward cognition. (Böttger & Költzsch, 2019: 13).

The brain regions integrated (see Fig. 12.3) into the network are:

– The posterior cingulum, a central structure of learning, correcting mistakes, analyzing pain, and reinforcing behavior.
– The precuneus, involved in visuospatial processing, episodic memory, and consciousness.
– The parietal lobe, associated with navigation, spatial sense, and the sense of touch.
– The temporal lobe, in charge of processing sensory input into meaning, emotional association, and language comprehension.
– The prefrontal cortex, responsible for general decision-making and social behavior (Böttger & Költzsch, 2019: 14).

Functionality of the DMN

Even though research on the DMN has accelerated in recent years, its main function is still unclear (Havlík, 2017; Vatansever et al., 2015). This could be due to the fact that there are several diverse examples of positive effects. These can be roughly summarized into three main fields which can all be linked to educational practices and in particular to the language classroom: personal development, creativity, and language production.

Personal Development

As already mentioned beforehand, the default mode network is connected to the emotional network and first and foremost processes self-referential information. This means that it does not take external stimuli into account but rather focusses on internal stimuli. An example hereof can be found while driving a car down a commonly taken route. As thoughts tend to wander off, the mind defocusses from the actual act of driving. Then, after arriving at the desired destination, it seems to be impossible to recall the memory of steering the vehicle or what had happened throughout the drive. This shows the extent to which the human brain is capable of ignoring external stimuli and in contrast is capable of fully concentrating on the aforementioned self-referential information (Buckner et al., 2008; Dixon et al., 2017; Immordino-Yang, 2016; Immordino-Yang et al., 2012; Raichle et al., 2001).

This central feature of daydreaming entails three consequences regarding personal development. Firstly, the emotional well-being of students is fostered. Due to intensive reflection on one's own character, actions, topics, or situations related to oneself, a stronger form of personal identity can be built. In subsequent instances of personal instability, such as receiving bad grades, this form of reflection becomes valuable as well as useful and helps handling such insecure moments (Immordino-Yang et al., 2012).

Secondly, such an in-depth and internal confrontation with knowledge regarding one's own past and future ensures the construction of personal meaning. Spending time reflecting on currently processed information helps to build "coherent, social-emotionally relevant narratives about one's own and others' values and life experiences" (Immordino-Yang, 2016: 214). These narratives are then again connected to meaning which each person makes of specific situations or decisions (Baird et al., 2011; Immordino-Yang, 2016). Research has also shown that students who are given opportunities to reflect on their knowledge and therefore establish greater personal meaning are also able to work more efficiently in the present (Damon, 2009; Immordino-Yang, 2016; Oyserman, 2015). For example, elementary school children, who were taught to self-reflect on their memories and feelings as well as envisioning an ideal self before making a new plan to pursue, showed a growth in not only emotional well-being but also self-confidence and academic achievement (Brackett et al., 2012). Looking at educational situations, this implies that students that are allowed to take a minute to reflect and therefore activate their DMN are more able to connect personal interest and meaning to the learning content.

In turn, this increase of personal interest leads to intrinsic motivation. Especially, unintentional contemplation on the future instead of the past during these times of daydreaming enhances internal ambition (Brackett et al., 2012; Oyserman et al., 2002). Buckner et al. even go so far as to describe the main function of the DMN as being able to "to facilitate flexible self-relevant mental explorations – simulations – that provide a means to anticipate and evaluate up-coming events before they happen" (Buckner et al., 2008: 2). Studies have shown that people who deal with imminent problems of the future in more detail are more capable of coping with

these difficulties later on as well as developing greater personal relevance and intrinsic motivation regarding these situations (Immordino-Yang, 2016; Medea et al., 2018; Smallwood & Schooler, 2015).

However, all three fields mentioned above, emotional well-being, personal relevance, and (intrinsic) motivation, are related to each other and form the basis of every educational framework with the goal of learning success in mind. Students who are emotionally stable have an easier time learning successfully. Nevertheless, intrinsic motivation equally enhances learning success, which then again leads to further motivation due to appreciation of one's achievement. This in turn supports the emotional development of the youth.

Creativity

Also, activating the DMN, letting the mind wander, and, thus, withstanding external stimuli lead to benefits in another field: creativity (Beaty et al., 2014a, b, 2016; Dijksterhuis & Meurs, 2006; Jung, 2013; Kühn et al., 2014; Sunavsky & Poppenk, 2019). Most advantages can be found in divergent thinking, meaning the process of exploring as many ideas as possible. This is due to the fact that there is a similarity between the creative process and the processing of self-referential thoughts.

The creative process itself, as it is depicted by the four-stage model by Wallas, can be divided into four steps: preparation, incubation, illumination, and verification (Gallate et al., 2012). The incubation stage is of particular significance in this respect. Theory suggests that during this stage, participants distance themselves from the problem at hand, do not consciously focus on it any longer, and instead consciously focus on a completely different task. This leads to an unconscious processing of the previous problem often resulting in an enlightening moment of finding a solution (Gallate et al., 2012). Interestingly, a recent study by Gable et al. (2019) showed that participants conceived more than 40% of their creative ideas while engaging in completely different tasks or thinking about completely unrelated issues indicating a connection of the previously mentioned incubation phase to the field of creativity. These phases of incubation seem to be even more successful while engaging in simple, non-demanding tasks (Baird et al., 2011; Böttger & Költzsch, 2019; Mason et al., 2007; Sio & Ormerod, 2009; Smallwood et al., 2009).

Although some studies (Berkovich-Ohana, 2017; Benedek et al., 2014) have also found negative correlation between parts of the DMN and the creation of creative ideas, one explanation for such contradictory results can be found in the study by Heinonen et al. (2016). Whereas in most studies participants are asked to verbalize their creative ideas, this study focused merely on the idea generation without any verbalization and examined the brain regions activated throughout that specific process. Their findings show that during this stage of pure divergent thinking, no negative associations were found with parts of the DMN. This suggests that simply the process of developing new ideas, prominent during the incubation phase, is linked

to the DMN, whereas other networks also play an important role in verbalizing and evaluating these ideas further on.

There has also been discussion whether or not immediate, in contrast to delayed, incubation is relevant to supporting creativity. Regarding divergent thinking tasks, it was shown that immediate incubation including unconscious work produced better performance than delayed incubation or conscious work (Gilhooly et al., 2012). Also, participants that were aware of the fact that they would be working on their original problem after the incubation phase showed better creative performance. Hence, the anticipation of a future task during the incubation phase might also be helpful in terms of creative thinking (Gallate et al., 2012). It becomes clear that no matter how the incubation phase is constructed, it, nevertheless, seems to foster creativity.

As divergent thinking includes perceiving problems from different perspectives, it makes sense how the incubation phase and the performance of an unrelated action help open the mind to different perceptions, thus leading to new solutions to the prior problem. Daydreaming is, therefore, not a threat to problem-solving but can rather be extremely helpful when it comes to creating new ideas and knowledge.

Interestingly enough, brain scans were also able to show that similar brain regions were active during creative thought as well as performing non-demanding tasks and thus activating the DMN. As already mentioned before, the main constituents of the DMN are the parts of the frontal, parietal, and temporal lobe, as well as dorsal-lateral parts of the cingulate cortex. Recent studies were able to show that parts of the prefrontal cortex, frontal lobe, and temporal lobe are equally active throughout creative thought (Ellamil et al., 2012; Smith & Smith, 2017; Green et al., 2012; Smith & Smith, 2017; Kounios & Beeman, 2014). In turn, this overlapping of both fields makes sense as the DMN is activated by processing stimulus-independent thoughts, focusing on internal reflection, as well as creativity, at least during moments of the incubation phase, and similarly concentrates on unconscious information processing.

Language Production (Performance)

As creativity is not only relevant as a skill itself, it is also valuable in connection with language and, therefore, language teaching. Drawing on general theories of foreign language didactics, it becomes evident which role creativity plays in this respect. For example, Bloom's taxonomy provides a hierarchy of all steps included in the learning process. After cognitive skills such as remembering, applying, or analyzing knowledge, creativity rests at the top of the pyramid. Of course, all parts of this taxonomy are interdependent, and creativity without all previous stages, hence without prior knowledge, is not possible. However, the taxonomy shows that the final step of developing language competences equals creative performance in a foreign language. It can be affiliated with communicative interactions, humorous use of speech, or experimenting with language (Böttger & Költzsch, 2019).

Furthermore, this form of experimenting with language demonstrates another aspect of language production linked to creativity: constructing hypotheses. According to the identity hypothesis, the process of second language acquisition includes creating hypotheses about the foreign language which are constantly tested and modified. By doing this, learners do not simply obtain language rules but instead creatively play with language.

Yet again, not only creativity is linked to language production but also to the implicit operations of the DMN. Considering cognitive activities connected to the activation of the DMN, e.g., introspective or self-referential thought, emotional processing (Broyd et al., 2009), spontaneous cognition, or predicting possible actions (Raichle & Snyder, 2007), there is a link between these implicit processes and language acquisition-related processes such as self-correcting and self-reflecting, unconsciously planning of the speech action, expressing personality through certain choice of words and expressions, or decision-making how to say what to whom (Böttger & Költzsch, 2019; Kuhnert et al., 2013).

Additionally, a recent neuroimaging study by Feng et al. (2019) was able to show a positive correlation between brain regions of the DMN and verbal creativity performance. More precisely, they examined the dynamic reorganization of brain networks and their connection to verbal creativity using the Torrance Test of Creative Thinking. As a result, they found that "individuals with greater creativity performance displayed stronger integration in DMN network" (Feng et al., 2019: 894). They traced this back to the fact that the DMN is responsible for internal mentation and mind wandering and, therefore, to the process of generating creative ideas, fostering the associations between old and new information as well as imagining future possibilities. In contrast, other brain regions and networks, such as the frontoparietal task control network or the auditory network, were responsible for selecting useful information in order to ultimately produce a creative idea.

All in all, this shows that the DMN and the process of mind wandering not only support the creation of new ideas but are strongly affiliated with using language creatively as well as acquiring a second language in the first place. As a consequence, there are several implications regarding foreign language teaching.

Implications for (Not Only) the Language Classroom

Optimal language learning environments include sustained, flexible attention and productivity in tasks which is the domain of the executive control network. Also, it involves reflection, memory, and meaning-making, domain of the default mode network, as well as emotional relevance, the domain of the salience network. Hence, the balance between these types of neural networks seems to be a main contributor to achieving the goals of the language classroom (Guy & Byrne, 2013).

Optimal language educational activities foster engagement and learning in (inter) culturally relevant, meaningful, and language productive tasks, including time and space for physical activity. They strongly motivate by coupling learners' interests

and relevance with accessibility, representing the right individual level of difficulty. Ideally, it is just beyond a learner's current competence in order to enable language acquisition progress. To be willing and able to solve challenging tasks, language students ought to learn to perceive themselves as capable of succeeding in demanding tasks, which shows the connection between cognitive and emotional capacities.

Language productive learning environments are well structured to be consistent with how the brain develops. They minimize outer influences like sound and light but include background music, if preferred. They also include story telling. They focus the learner's emotional and social experience; foster the language learners' subjective perceptions, e.g., feelings; and help them build positive academic and social identities through new skills and knowledge. They provide emotionally safe harbors where strong relationships are built among adults and children. Above all, language learning is relationship learning.

In meaning-making language classrooms, students engage in tasks as scientists, explorers, linguistic toddlers, and artists. They take on academic roles while learning language concepts, skills, and strategies. They are encouraged to engage in experimental learning and try not to prevent mistakes but rather draw from them as they have derived from previous learning hypotheses and lead to new ones.

Productive language learning environments in a positive atmosphere support age-appropriate autonomous learning with a flexible planning, exploration, and discovery, followed by self-monitoring, reflection, and discussion for deeper understanding. They themselves decide on when to stop their language learning process, to take an essential mind wandering "break," to dig deeper when necessary, and to gather more information, to seek or even to offer help.

Language tasks in which students implicitly explore essential questions with a partner or in small groups or even a mix of group and individual work require figuring out:

- How things work and how language works.
- Why a (language) phenomenon is as it appears.
- How to find a solution to a problem.
- What the consequences are if something is done, said, or written in a particular way.

Moreover, open access to materials, equipment, and tools is required to be able to answer and share their thoughts as well as problem-solving strategies. This partially or fully equals the concept of task-based teaching and learning in authentic and motivating surroundings.

Basic language skills coincide with complex thinking and reasoning which are consistent with current models of brain network development. Certain automated basic skills ensure flexible movements between exploration, reflection, and practice. Balancing demanding and non-demanding tasks has the same effect. All this strongly supports efficiency and plasticity in brain development. It is also evident to enable students to learn language symbol systems like the basic academic skills of phonological decoding. This can strongly support organizing the brain for higher academic skills like literacy – all through practice over time. Brain processes of

reasoning, conversing, exploring, and conjecturing strengthen the coherence and balance of brain networks. For instance, when reading should make sense, it requires far-reaching abilities and knowledge of the world that support understanding of the text. Also, it demands decoding skills and sustainable attention. In all, the most effective language educational strategies allow students to develop conceptual understanding when they engage in hands-on learning and higher-order thinking.

Language learning requires open minds. That includes bi- or multilingual environments which can offer cognitive, social, and emotional benefits for teachers and students. Multilingual activities enhance the development of the brain, the perception of patterns, and reasoning abilities through higher verbal expression in all subjects. Open-minded cooperation and communication without performance pressure rather than competitive settings develop characters further, as they emphasize on empathetic behavior patterns – a foundation of successful communication.

Limitations of the DMN

Of course, criticism of the DMN and its positive functions has also arisen highlighting its negative effects. These include, for example, interruption of attention, loss of focus, time loss, frustration, or depression (Smallwood & Schooler, 2015; Taruffi et al., 2017; Birbaumer & Zittlau, 2016). All these negative impacts are by all means plausible. However, according to the Context-Regulation Hypothesis from Smallwood and Schooler (2015), mind wandering is always as helpful as the context in which it appears. They argue that "cognitive functioning may be maximized if mind wandering is limited to nondemanding circumstances rather than avoided entirely" (Smallwood & Schooler, 2015: 506). Danckert and Merrifield (2018) differentiate between two types of mind wandering: deliberate and spontaneous. Spontaneous mind wandering may entail positive effects; it is most likely also the one to contain the abovementioned risks as it is often connected to boredom. In contrast, deliberate mind wandering exclusively leads to positive effects as it can be controlled more easily.

Conclusion

Taken together, it becomes clear that the aforementioned human brain networks, most importantly the DMN, provide for numerous positive phenomena such as emotional growth or enhanced meaning-making. Subsequently, these favorable effects can be used in various educational contexts and are particularly helpful regarding the language classroom as they help students learn by exploring language creatively as well as bestowing its content with greater personal meaning.

However, the limitations also show that these secret powers of the DMN and, thus, a wandering mind do not simply occur on their own. The DMN itself that

merely works in connection with other brain networks indeed benefits from such countereffects. This interdependency of the networks, i.e., the alternation between mental concentration and rest, is the "magic formula" behind these secret powers. Consequently, it is essential that the correct usage of the DMN is learned beforehand. Students need to understand that knowledge of these brain networks can help them overcome mental blocks and that they can benefit from such experiences but must know when and how to implement this knowledge.

In conclusion, it can be stated that brain networks like the DMN are truly helpful if they are not considered in isolation. Future research must therefore provide insight into the joint activity of these networks and especially in actual classroom settings.

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Chapter 13
Is a Wandering Mind an Unhappy Mind? The Affective Qualities of Creativity, Volition, and Resistance

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Introduction

Mind wandering research has seen an exponential rise since the phenomenon's first appearance in the work by Smallwood and Schooler in 2006. During this early period, mind wandering was considered to be an issue that intervened in experimental settings while trying to decipher the functioning of different psychological processes, among these are perception, working memory, and attention, to name a few. Researchers observed that some of the participants, when entering the laboratory setting, got distracted from the task at hand. As of that, bias was being introduced to the study results due to impairments in performance that were driven by unknown factors. Subsequently, with the realization that the described phenomenon was common and cross sectional to participants in laboratory settings, they decided to elevate it to a research topic of its own.

The wandering mind was first defined as "a situation in which executive control shifts away from a primary task to the processing of personal goals" (Smallwood & Schooler, 2006, p. 946). In the same line, a large extent of the literature into the topic so far has proposed mind wandering as an attentional decoupling between external stimuli and an internal focus of attention (Christoff et al., 2016; Seli et al., 2015b, 2017b). This phenomenon has been studied in various contexts, such as education and clinical and labor psychology, among others. In these disciplines, research has often indicated a direct correlation between the presence of mind wandering and negative outcomes such as low academic achievement, attention problems, depressive symptomatology, rumination, and work and domestic accidents, among others (Mooneyham & Schooler, 2013; Seli et al., 2015a, b, 2017a, b; Christoff et al., 2016).

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All of the previous studies have explored the consequences of mind wandering. Among these, one of the most iconic studies that sought to analyze the relation between mind wandering and overall subjective well-being consulted a sizeable sample about their thoughts in different moments during the day (Killingsworth & Gilbert, 2010). The team of researchers developed a phone app which probed participants in regard to (a) what they were doing at that moment and (b) whether their thoughts were focused on the task being carried out at the time or on other unrelated contents. The researchers then correlated these results with the level of subjective well-being reported by the same participants. The results of this study established a link between low levels of subjective well-being and exacerbated off-task mindsets. In other words, people who were focused on the task being carried out in the present showed a higher level of subjective well-being.

On the other hand, scarce studies have highlighted the positive consequences of mind wandering. In this regard, recent studies – however sparse – have evidenced the prominent role that mind wandering plays in creativity (Mooneyham & Schooler, 2013).

Creativity can be defined as a complex and continual psychological process, one that is future oriented and consists of the construction of meaning (verbal or imaginary) in order to redefine a situation. It is also related to the ability to imaginatively project into the future, such that it opens up different possibilities for action and/or creating new social and cultural products (Awad & Wagoner, 2015). However, the creative process is not free of "constraints", and adding to those of external nature – physical or social – a lot of them tend to become internalized, thus able to exert influence from within an intra-psychological space. Therefore, the resistance that a person directs into overcoming different types of restraints is fundamental to the creative process.

Resistance constitutes a form of opposition to representations, practices, dominant institutions, and a person's own internal restraints (Awad et al., 2017). It can be conceived as an intentional process whereby new constructions of meaning in the way of thinking, feeling, acting, or simply living with others arise (Chaudhary et al., 2017). Resistance is both a social and an individual phenomenon and alludes to any form of dissent toward a social phenomenon or practice by a group or individual (Chaudhary et al., 2017). Through the process of resistance, human beings can transform their subjective experience and build meanings that enable the modification of the environment in which they live. In this line, the phenomenon known as resistance constitutes a building block in individual and sociocultural development (Chaudhary et al., 2017).

This chapter's objective is to advocate for the significant role that mind wandering, as an affective expression, plays in the phenomenon of creativity and, additionally, to explicit the function to both serve - creativity and mind wandering - as a form of resistance against environmental demands or "tasks" and personal barriers.

A Task-Oriented Paradigm

Mind wandering has been a subject of scientific studies in psychology for over a decade (Fossa et al., 2018a; Smallwood & Schooler, 2006; Vannucci & Agnoli, 2019; Villena-González, 2019) and, during this time, has become one of the fastest growing topics within the cognitive sciences' branch of knowledge (Irving, 2016), as this period has even been considered to be the "era of mind wandering" (Irving & Thompson, 2018).

The first appearance of the concept in experimental psychology was in Smallwood and Schooler's (2006) work, in light of the observation that study participants exhibited significant amounts of inattention during experimental task's settings. According to the article, mental wandering was defined as a phenomenon in which the focus of attention shifts away from a primary task and is redirected toward the processing of internal information. This would happen due to a deviation of executive control when two competing focuses of attention are simultaneously present (Fossa et al., 2018a). In Smallwood and Schooler's own words: "mind wandering is a situation in which executive control shifts away from a primary task to the processing of personal goals" (Smallwood & Schooler, 2006, p. 946). However, in light of further findings, the authors proposed a revised definition, which considered the phenomenon of mind wandering to be a variation in thought that drifts away from a current task or the external environment and is directed toward self-generated thoughts and feelings, which are internally motivated (Smallwood & Schooler, 2015). Other works have defined mental wandering as an unintended attentional decoupling between an external stimulus and an internal thought (Kopp & D'Mello, 2016; Maillet et al., 2017; Smallwood et al., 2003; Smallwood & Schooler, 2006). Lastly, being one of the most prevalent definitions, stands the notion of mind wandering as task unrelated thought (Fox & Beaty, 2019; Irving & Thompson, 2018; Villena-González, 2019). This definition entails a process by which attention is internally oriented through a neural mechanism of suppression that inhibits the focus on external information (Villena-González, 2019).

Aside from mainstream cognitive psychology and further back from recent years, one of the first authors to approach the topic of discussion was Vygotsky (1934b), who proposed inner speech as the capacity of consciousness to speak to itself. In his work, he attributed a problem-solving function to this feature of human experience.

Mental wandering is an inherent characteristic of human beings (Killingsworth & Gilbert, 2010; Villena-González, 2019) and occupies close to a third of people's waking thoughts (Mills et al., 2018). This phenomenon has such a significant prevalence that some accounts have estimated the number of self-generated thoughts in a single day to be as high as 2000 (Fox & Beaty, 2019).

People tend to wander when the demands of the external world are minimized, for example, during simple or highly practiced tasks (Fox & Beaty, 2019), as well as during long and monotonous tasks when activities lack diversity and scenarios provide little motivation (Villena-González, 2019). This can be explained by humans

having a hierarchy of goals, because of which attention is deviated to an alternate objective that becomes active, thus eliciting an episode of mental wandering (Fossa et al., 2018a). Such episodes of attentional drift have been linked to an individual's motivations (Smallwood & Schooler, 2015), along with the person's present concerns and goals (Vannucci & Agnoli, 2019). Interestingly, the empirical evidence that suggests personal goals play a prominent role in mind wandering lies somewhat opposite to common sense psychology in the belief that the phenomenon seems to be essentially purposeless (Irving, 2016).

From the perspective of neuroscience, evidence has pointed out that the crucial regions involved in the onset of self-generated thoughts are the medial temporal lobe (MTL) – especially the hippocampus – and the default mode network (Fox & Beaty, 2019; Vannucci & Agnoli, 2019), along with prefrontal executive areas (Vannucci & Agnoli, 2019). The activity in these networks explains the tendency toward self-referential processes and the continuous human gravitation toward personal concerns and unresolved issues (Vannucci & Agnoli, 2019). Moreover, lesions in the medial temporal lobe can result in an inability to create new plans and imagine possible simulations of the future. It is to be noted that such lesions do not alter the frequency of mind wandering episodes but only restrain their content, which turns more semantic, verbal, and present centered (Fox & Beaty, 2019).

Due to the fact that mind wandering is a very young field within the cognitive sciences, some fundamental issues still remain unsolved. One of the most crucial problems is evidenced in the diversity of interpretations of the phenomenon, which entails a lack of consensus in the establishment of a definition to serve as a common ground of understanding—thus affecting the validity of constructs in empirical efforts (Christoff, 2012; Irving, 2016; Irving & Thompson, 2018). In this paramount matter, philosophy has come to contribute with a novel and encompassing approach, by proposing mind wandering as a form of unguided thought (Irving, 2016; Irving & Thompson, 2018). That is to say, "When the mind wanders, the focus of attention drifts unguided from one topic to the next" (Irving, 2016, p. 563). However, attention is not deviated purposelessly or randomly, but without guidance (Irving, 2016).

This definition arises as criticism to the traditional notion of mind wandering as task-unrelated thought, due to severe limitations in such an approach. For one, (1) it does not take into account the dynamics of mind wandering episodes and (2) other types of task unrelated thoughts. Also, (3) it does not explain how the content of mind wandering can be related to a main task (Irving & Thompson, 2018). Finally, (4) a shift in the focus of attention might not always mean that a person is engaging in mental wandering. Sometimes it may just reflect that the individual has switched between tasks. The advantages of this new definition are that it captures the dynamics of mental wandering and allows to establish a clear difference between it and other kinds of task unrelated thoughts (Irving & Thompson, 2018).

The description of two variations of the phenomenon has been one of the breakthrough contribution related to mind wandering, deeply influencing the trajectory of the research field (Agnoli et al., 2018; Fossa et al., 2018a; Vannucci & Agnoli, 2019; Villena-González, 2019). As to these two types of wandering, the main difference resides in the degree of purposefulness and cognitive control over the start of an

episode. That is to say, the difference regards the underlying mental dynamic at the beginning of the experience (Vannucci & Agnoli, 2019). The first one, known as unintentional mental wandering, has been described as being caused by a failure in the executive control of the attentional focus and, due its nonintentional characteristics, appears suddenly in what literature sometimes refers to as unsuitable situations (Villena-González, 2019). In other words, there is a change in an individual's mental state in which the focus of attention drifts from external stimuli to internal thoughts in a spontaneous, uncontrolled manner (Agnoli et al., 2018; Vannucci & Agnoli, 2019). Some accounts have described costs associated to these types of episodes (Fossa et al., 2018a; Villena-González, 2019) and unintentional mental wandering has even been linked to outcomes such as ADHD, OCD, self-reported anxiety, the tendency to act impulsively, distraction, and other attentional difficulties (Agnoli et al., 2018). The second type, called intentional mind wandering, refers to the cases in which the focus of attention intentionally drifts away from an ongoing task toward internal thoughts. This references a process that happens under the individual's control (Vannucci & Agnoli, 2019) and that enables a certain kind of guidance in the content of thoughts, unlike the case of unintentional mind wandering (Villena-González, 2019).

Intentional mind wandering is often associated with benefits due to the individual's capacity to control its occurrence (Villena-González, 2019). For example, it has been shown to improve the capacity to describe internal experiences, which in turn is a predictor of creative achievement (Agnoli et al., 2018).

For that reason, being a heterogeneous phenomenon that can take numerous forms, and thanks to its capacity to create diverse and complex mental scenarios, mind wandering does not always entail negative costs (Villena-González, 2019). Specifically, some authors have suggested that the costs and benefits rely upon the individual's capacity to regulate the content of thought itself and the occurrence of mind wandering in regard to the context (Villena-González, 2019). In relation to the above, "neurocognitive research has clearly shown that MW is far more than a failure to constrain attention to perception, but it is instead a remarkable mental activity, which entails complex higher-order functional and neural mechanisms" (Vannucci & Agnoli, 2019, p.247). All things considered, cognitive research has been keen on accentuating the phenomenon's negative features, due to the fact that mental wandering tends to be only useful or appropriate for the persons experiencing the thoughts themselves (Fox & Beaty, 2019).

The Affective Mind

As has been stated, a large body of research has focused on the mind wandering phenomenon in recent years. This movement has been unveiling – or rediscovering, if one takes into account the traditional branches of psychological knowledge – multiple dimensions of thought. For the past two decades, the nuances of thought in everyday life have been scrutinized, and mind wandering has stepped into the

spotlight of current scientific efforts. With it, serious debate topics have emerged among scientific communities regarding the conceptual understanding of the phenomenon and the conclusions that can be supported by available empirical data. One of the most controversial topics in question has been the emotional correlate of the mind wandering phenomenon.

This controversy is quite understandable, emotion being such a complex and ubiquitous aspect of human experience. Within the subject of mind wandering, recent findings and literature reviews have made it possible to assert that around two thirds of self-generated thoughts are emotion related in some form (Fox et al., 2018).

So how exactly does the affective experience reflect on mind wandering? And equally important, how does the wandering mind reflect on affective experience?

Do note that in the previous questions the focus of this section and chapter was elevated from emotion to affectivity as a broader and more comprehensive phenomenon. Affective experience can be better understood under the scope of Vygotsky's perspective. In his work, he advocates for the existence of a volitional-affective tendency behind every thought. Due to this proposition, he coined the notion of a volitional affective sphere of consciousness (VASC) (Vygotsky, 1934b).

The concept of a volitional affective sphere of consciousness has served psychology by providing an answer to the ultimate "what?" in the analysis of thought and its underlying process. Following this logic, the VASC refers to the motives that constitute thought's foundations in consciousness, namely, physical and affective needs, impulses, and interests, among others (Vygotsky, 1934b).

Over this framework, the current section draws on research and conclusions of the wandering mind literature in two main topics – emotional valence and volition – to elucidate the relationship between the mind wandering phenomenon and affective experience.

Emotional Valence

Research in mind wandering made its way into cognitive literature by trying to explain and account for task-unrelated thoughts or "noise" in experimental settings (Smallwood et al., 2003; Smallwood & Schooler, 2006). In essence, the phenomenon was conceived as an undesirable byproduct of human experience from the onstart. In this line of thinking, strong claims have been made along the years as to the role of mind wandering in affective experience. Among these, one of the most sentencing conclusions reached was from the experiment by Killingsworth and Gilbert (2010), whose article stated unequivocally that "a human mind is a wandering mind, and a wandering mind is an unhappy mind" (p.932) – quite a hopeless conclusion to reach and also one with serious consequences to the understanding of mental health. The results from this paper's experiment showed that people were only equally or less happy when thinking about something other than their ongoing or current activity, regardless of the nature of the activity in question and the content of the task-unrelated thought itself. It also determined that people's thoughts were a better

predictor of their happiness than the activity they were engaged in, since it accounted for a larger portion of the happiness' variance. Moreover, the article goes as far as to propose a causal relationship between mind wandering and unhappiness (Killingsworth & Gilbert, 2010). However, since the release of this paper close to a decade ago, a large number of studies have come to shed new light to the misunderstood phenomenon of the wandering mind.

In 2018, Fox et al. published a comprehensive literature review – covering a dozen independent studies which involved more than 5000 participants – assessing the role of emotion in self-generated thought, such as mind wandering. In this review, a couple of major conclusions are drawn from the available empirical data. The first point that should be addressed is how TUTs (task-unrelated thoughts) have been exposed as poor measures of mind wandering during recent years, given they don't capture the most relevant aspects of the phenomenon and the qualities of thought, such as its freedom of movement (Andrews-Hanna et al., 2017; Fox et al., 2018; Irving, 2016; Mills et al., 2018). Further on, equating mind wandering to TUTs or an attentional decoupling also ignores other critical dimensions of self-generated thought. One of such is intentionality, which is predictive of clinical symptomatology, goal relatedness, and the affective valence of thought (Fox et al., 2018; Seli et al., 2015a, 2017a, b). One of the best documented findings in literature so far is the ubiquity of emotional content in self-generated thoughts, it being present in between 50 and 67 percent of wakeful SGTs (self-generated thoughts). Additionally, SGTs can have a wide spectrum of emotional content, comprising most – if not all – human emotions (Fox et al., 2018). In addition, experimental paradigms that induce specific types of emotions have been shown to affect the overall frequency of mind wandering episodes, thus reinforcing the close relationship between emotion and self-generated forms of cognition (Fox et al., 2018).

Regarding the conclusions by Killingsworth and Gilbert (2010), it has been found that there is actually little evidence to support the assertion that TUTs are a causal factor of subsequent negative mood. New evidence has shown that the relationship between TUT and subsequent moods is dependent on different factors, such as the content of thought – temporal orientation and emotional valence of the TUT itself – and other clinical or subclinical symptomatology of the individual. Furthermore, one of the most robust findings in SGT literature is a notable bias of it toward positive or pleasant affect (Fox et al., 2018). Instead, the relationship between the affective content of self-generated thoughts and an individual's affective state has recently been shown to be bidirectional in nature, since both are able to bias the other one. Different studies have effectively revealed that the affective qualities of SGTs rest on multiple factors. Among these factors, innate predispositions, paradigm context, individual affective traits, clinical conditions, and deliberate mental training have been found to exert a significant influence (Fox et al., 2018).

The Volition Dilemma

For quite some time, mind wandering was presumed to be an unintended attentional decoupling or drift away from a task at hand. This stereotypical way of understanding the phenomenon was most likely rooted on the youth of the field in cognitive literature and in the predominance of task-oriented scientific paradigms of study (Kopp & D'Mello, 2016; Maillet et al., 2017; Smallwood et al., 2003; Smallwood & Schooler, 2006, 2015). However, major breakthroughs have been made since the phenomenon started getting attention close to 20 years ago. The topic has, since then, been expanded to address other critical features of spontaneous thought and its dynamics in more comprehensive and accurate conceptualizations (Andrews-Hanna et al., 2017).

Arriving at the topic of this section, the unintended nature of mind wandering was first challenged in the works by Seli, where the notion of intentionality in spontaneous thought was invited into scientific discussions (Seli et al., 2014, 2015a, 2016, 2017a, b). By advocating for the existence of intentional and unintentional types of mind wandering, the authors of these papers started differentiating between mind wandering episodes in terms of their process. The first of the mentioned processes refers to a deliberate mechanism, in which the focus of attention is directed by what the authors consider to be willful or volitional action. The second, on the other hand, refers to a spontaneous mechanism, in which attention is "captured" either by internal or external forces (Seli et al., 2016). Intentional and unintentional types of mind wandering have been, in this perspective, homologated to voluntary and non-voluntary kinds of cognition (Fossa et al., 2018a).

So, is unintentional mind wandering completely lacking volition?

Irving (2016) proposed an interesting perspective that gets closer to the reveal of this plot. In his article, he states that the central features of agency – motivation and guidance – come apart when the mind wanders. In his theory, the distinction between motivation and guidance in thought is that the first concerns its causal antecedents, while the second concerns how it unfolds over time. Motivation, in this sense, includes the agent's beliefs and desires or goals, while, on the other hand, guidance implies how thought is monitored and regulated in a conscious manner. According to Irving's theory, mind wandering stands in a middle ground between controlled mental agency, such as reasoning and planning, and unconscious automatic cognitive processes. The latest explanations of mind wandering are formulated in this line of thinking, referring to how thoughts unfold over time given the constraints, both deliberate and automatic, that dynamically influence its contents (Andrews-Hanna et al., 2017).

But the main topic of this discussion still seems to be somewhat eluding the argument, which is affectivity, right? So how exactly is volition related to affectivity?

This question can be addressed by resuming Vygotsky's cultural-historical theory. Vygotsky states that the division between the intellectual and affective aspects of consciousness is one of the most serious misconceptions of all traditional psychology. In his work, he strongly advocates for the indivisible nature of the bond

between volition and affectivity in thought. As was mentioned at the beginning of this section, Vygotsky describes a volitional-affective sphere of consciousness that keeps on challenging today's conceptualizations regarding the volitive aspect of thought (Vygotsky, 1934b). The foundational tendency of thought proposed by Vygotsky, both volitional and affective at the same time, becomes more evident as the depth of the analysis reaches closer to the genesis of thought and consciousness (Vygotsky, 1934b).

Even in a very basic example, it could be argued that the act of a person taking a break from an assignment, standing up, and walking to the fridge to pick up and eat a piece of fruit does not represent a single instance of willful action. The action is more like a culmination of a physical and mental process whose initial stage begins with the feeling of hunger and the craving for a food of personal enjoyment. This would be the thought's foundation in consciousness, which is, from this perspective's point of view, already volitionally charged. Afterward, the process does arrive at more executive levels of thought, in which the person might check the watch to see if it is an appropriate time for a snack, or recall what they bought on the last trip to the supermarket.

While not immediately apparent to the observer, the person's will has already begun manifesting in the first steps of the process, for a number of choices have been made at its very origin. By the time a fruit pops up in the person's mind as a thought, their "decision" to not desire any other of the vast number of foods out there in the world was already half made. And so, by the time they deliberately decides to mentally entertain the possibility of leaving their current task aside and focusing on getting something to eat, a great deal of their will in that process has already been exerted.

What if the person in the example was actually in the middle of a diet, trying to lose weight, and perceived the physiological hunger signal in a positive way? Like a signal of their goal being achieved. In this case, the perception of the affect was previously primed along with the willful decision of not having food in spite of being hungry. How can affect be isolated from volition in such a case?

And what if the same example was traced the furthest back into genesis?

Take a newborn that cries when feeling hunger (affect). Most people would argue, with reason, that the infant's cry is an experience completely driven by their survival instinct and thus lacks any form of willfulness. Nevertheless, the quality of that affective experience of hunger and its corresponding physiological correlate can, indeed, be very different for another child. Consequently, the quality of the mental presentation or image – if any – and the reaction is also subject to the idiosyncrasy with which the baby experiences the affect. In certain infants, the physiological correlate of fear might be intensified due to the sensitivity in the functioning of a specific neural network, while in others the experience might be biased toward the other end of the spectrum.

Whether these types of idiosyncrasies can be considered as a form of volitive exercise or not is a philosophical debate that exceeds the grasp of this section. But the previous example allows to introduce another factor or ingredient to the mix, which is: What happens after a little learning kicks in?

Fast forward to the scenario when the same baby's mother has breastfed her child over a couple of weeks or months when she starts perceiving a side preference by the infant. Perhaps she notices it because it takes the child longer to accept one side over the other. From the baby's perspective, it is plausible that the grip of the mother's arms on one side causes latching on to feel better and more comfortable overall, and thus the experience is more rewarding. Or maybe even perceives the taste or temperature of the milk to be so slightly different.

What is to be highlighted from this example is how the behavior of infants at this point reflects that they are somehow aware of the differences between the two experiences and, as of that, have developed a desire (affect) not just for nourishment but for the better experience that the one side provides. This is evidenced in the behavior of waiting to see if they get switched to the favorite side when not placed there initially. A preference was established between two simple choices, and the volitional aspect of the behavior is now intertwined with the corresponding affect in consciousness through learned experience.

Another crucial concept by Vygotsky finds its way into the argument at this point, which is the internalization of the outside world into the human psyche. As was explained, it is this phenomenon that best accounts for the indivisibility between affect and volition in thought (Vygotsky, 1934b). That is, as the learning process and the internalization of the external world take place, the relation between affectivity and volition becomes increasingly complex. This means that an affective experience – in the broad sense of the word – may carry along decisions of greater or lesser complexity with it.

What is volition then?

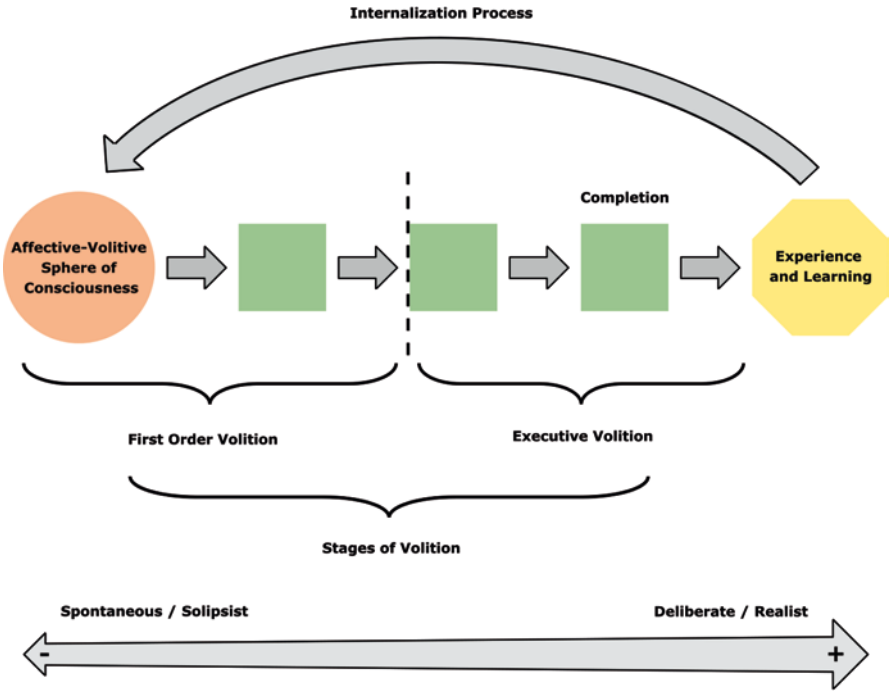
A Matter of Choice

The simplest definition for what constitutes a volitive action should be constructed around the metric of choice. Where there is choice, or any more than one possible mental and physical response to an affect or stimulus – in spite of how automatic or ingrained it might be – there is some form of volition. There are, therefore, enough arguments this far to draw a line between instinct and the volitional nature of affective experience. Thus, it could be argued that the first instance of learning signifies the transition between a pure instinct and any other thought/action with an affective-volitive tendency, as described by Vygotsky (1934b) in his work. This raises the question of "what are the implications of this definition to the notion of mind wandering with and without intention?"

Two Levels of Volitive Action

It is more or less clear what volition means for cognitive literature: the deliberate, controlled, or executive guidance of thought's content in a certain direction, topic, or task. This type of thought is arguably cultural and modern in its origin, for it can

be conceived of as a product of socialization and schooling. Yet, in the light of the present argument, another level of voluntary action comes off and needs to be accounted for. This non-executive volitional-affective tendency described by Vygotsky (1934b) could be thought of as a first order kind of volition. This new – or perhaps older – level of analysis lays the ground for some interesting questions and insights regarding spontaneous thought and mind wandering, as currently understood in cognitive research. It could be proposed, for example, that during involuntary mind wandering in task-oriented activities, there is a struggle of wills between the socially constructed and externally demanded executive level and the more primary affective willfulness. On the other hand, intentional spontaneous thought would present itself as a subtle integrative or convergent process between cognitive control and affective willfulness. One of the best examples to illustrate this point would be people waking up only to deliberately attempt to fall back asleep to a joyful dream they were having.



Note. Self elaboration.

Fig. 13.1 Cicle of Volition

A Continuum of Volition

There is, however, a second reading into the two levels of volitive thought/action. This possibility is to understand volition as a continuum with different stages and sequential orders of magnitude. Recapitulating Vygotsky's work, much like the word isn't merely the representation of thought, but the final stage which completes it; it could also be argued that deliberate action or thought is not a single instance of volitive exercise, but the culmination of the process of volition to a higher order or degree (Vygotsky, 1934b).

Figure 13.1 illustrates this cyclical process of volition, how it is related to a control dimension of thought, and how the affective-volitive sphere of consciousness relates to learning through the process of internalization. In the figure, each square accounts for a stage within the volitive process, which can be divided between orders of magnitude as they correspond to a specific location in a control continuum of thought.

The Deliberate Against the Spontaneous: Polarities of Control

There is solid scientific evidence supporting the depiction of a continuum between the spontaneous and deliberate nature in the display of psychological phenomena, specifically regarding the wandering mind topic (Andrews-Hanna et al., 2017; Seli et al., 2014, 2017a, b). While in early definitions of mental wandering the phenomenon was considered as an "unintended" deviation of thought, recent research and conceptualizations have described a deliberate dimension to it (Seli et al., 2015a). Correspondingly, various theoretical and empirical studies have modeled deliberate, spontaneous, and also intermediate types of mental activities (Andrews-Hanna et al., 2017; Fossa et al., 2018a). This continuum between spontaneous and deliberate thought adds complexity to the understanding of mind wandering as a dynamic phenomenon that can take numerous forms. The notion of a continuum becomes fundamental when addressing mixed types of thought phenomena, where spontaneous and deliberate elements intertwine to produce a multiplicity of experiences that call for nuanced explanations and interpretations. This perspective emerges from the fact that, taking its trajectory into account, any given thought can hardly be considered as being either completely deliberate nor completely spontaneous (Andrews-Hanna et al. 2017; Fossa et al., 2018b).

In this field of research, efforts have been mainly focused on describing the features of controlled, opposite to spontaneous, thought. Deliberate thinking has been described as task-oriented, presenting greater extent of words, less emotionally charged, denotative, propositional, realist, and a core attribute in problem resolution (Fossa, 2017; Fossa et al., 2018b). On the other hand, spontaneous thought has been described as contemplative or self-contemplative, affective, imaginative, pre-verbal, and non-propositional (Fossa, in press; Fossa et al., 2018b).

Over the years, research on mind wandering has also proposed an intentional or voluntary form of the phenomenon, which adds nuances to its classical depiction as an unintended or involuntary type of experience (Seli et al., 2015a). Research has shown that the onset of an episode of mind wandering is mainly a spontaneous and unintentional event, but its continuity or sustain over time can be intentional and controlled (Seli et al., 2015a). An example of this is a study that proved people's capacity to modulate the occurrence of mind wandering when a cognitive task was impending, which evidences a decision to stop wandering as cognitive resources need to be recruited for the execution of another pressing activity (Seli et al., 2017a, b).

The dialectic between the deliberate and the spontaneous in mind wandering may also be appreciated in creative processes. Even if creative thinking might appear to be completely free, unconstrained and spontaneously presented in consciousness at first sight, its development and execution can certainly have a deliberate, directed, or controlled component to it. As described by Vygotsky (1934a), for creative thinking to be manifested, a preparatory stage of stepping away from reality is required, that is to say, a certain degree of spontaneous and less constrained wandering. However, this stage can't disregard the constitutive principles of reality if it is to have any sort of transformative impact over it.

In this sense, due to its functional dynamics and expressive features, mind wandering and creativity appear to be processes directly related to each other.

Imagination, Thought, and Creativity

In the conferences on psychology, specifically in the conference n°5 – *imagination and its development in childhood* – Vygotsky (1934a) sheds light into the existing relationship between thought, imagination, and creativity. Even though in several of his previous works (Vygotsky, 1934b, 1982) he highlights the importance of inter-functional connections, explicitly stating that all psychological processes must be studied in their dialectic and dynamic interactions and not in an isolated manner, it is in the conference n°5 where he approaches the problem between the three mentioned specific functions. Inter-functional connections, from this perspective's point of view, refer to the units of analysis that lie in between of psychological processes.

To Vygotsky, the main difference between imagination and other forms of mental activity lies in the following: imagination does not repeat previously accumulated isolated impressions but builds new series from them (Vygotsky, 1934a). In Vygotsky's words:

> That is to say, the new that is contributed to the development of our own impressions and the changes in them that result in a new image, previously nonexistent, constitutes, as is known, the basic foundation of the activity we call imagination (Vygotsky, 1934a, p. 1).

To Vygotsky, social or realist thought is different from egocentric or solipsist thought. The first is a form of thought oriented to the knowledge of reality – the

task – while the second is an "autistic" form of thought, oriented to the self and the pursuit of pleasure. Mental images are present to a lesser extent in reality-oriented thought, while pleasure-oriented thought is directly related with what is known as imagination.

In the named conference, Vygotsky (1934a) states:

> It is understandable that every step in the conquest of a deeper penetration of reality is accomplished simultaneously with the freedom, to a certain extent, from the more primitive form of knowledge of reality that the child used to have. Every deeper penetration into reality demands a freer attitude of consciousness towards the elements of that reality, a distancing from the apparent external aspect of reality given immediately by the primary perception, the possibility for evermore complex processes, with the help of which cognition of reality is complexified and enriched (Vygotsky, 1934a, p. 11–12).

In the previous quote, Vygotsky alludes to a complex process between connection and disconnection of reality as a fundamental basis for the process of imagination. Paradoxically, that is to say, the process of imagination is only possible through a process of distancing from reality to then be able to understand it in a more complex and dynamic way.

From Vygotsky's (1934a) perspective, imagination is divided between a reproductive and a constructive kind. Reproductive imagination enables the use of previous images within consciousness, knowingly what is known as memory. On the other hand, constructive imagination enables the integration of new combinations from previous elements. This last process is what has been called creative imagination or, more directly, creativity.

Creative imagination has a considerable affective basis, which means this type of thought is affectively motivated at least to a greater extent than a realist thought (Vygotsky, 1934a). Notwithstanding, in occasions where an individual must perform a vital or motivating task, a heavily affectively charged type of directed-controlled thought may also be present (Vygotsky, 1934a). This last type of thought, under the mentioned conditions, may generate far more powerful emotional effects than creative imagination, for example, in the argumentation of a political discourse or the drafting of a project in which the person has absolute conviction. In Vygotsky's words:

> Realist thought, when related to a task that is important to the individual, that lies in one or other way in the center of his personality, provokes and awakens a series of emotional sensations, with a far more considerable and true character than imagination and the ability to dream. If we take the realist thought of a revolutionary, who reflects upon a complicated political situation or studies it, who penetrates into it, in a word, if we take a thought oriented to the resolution of a task of vital importance to the individual, we see that emotions related to such a realist thought are frequently immeasurably deeper, stronger, more mobile and more significant in the system of thought, than emotions related to visions. What is important here is a procedure of union between emotional and thought processes (Vygotsky, 1934a, p. 10).

However, due to the multiple inter-functional forms that human's consciousness takes, realist thought has an intersection point to creative imagination. Creativity cannot fully and freely display when every element of reality is stripped from the

process. If it was, the phenomenon would lack any sense and creative power in reality. Creativity implies and requires, to a certain extent, realist thought (Vygotsky, 1934a). In creativity the borders between realist thought and imagination dilute. For thought to be truly creative, imagination and realist thought must be integrated. Or, put in another way, imagination needs to appear as a necessary and inseparable moment with realist thought (Vygotsky, 1934a). Only then that the emergence of new connections between previous elements may have a space in reality and be qualified as creative.

From Alessandroni's (2017) perspective, creativity is a superior psychological process whose ontogenetic origin is cultural-historical and is related to contexts of everyday activities where instruments of semiotic mediation come into play. Creativity is a developing function that ranges from social interactions to self-regulation and relates both to cognitive processes and to the affective aspects of people's lives.

Vygotsky arrives at the conclusion that imagination and creativity, characterized by being able to freely process the elements of experience, require the inner freedom of thought, action, and cognition as a precursor (Alessandroni, 2017). Hereby, the problem of creativity meets the problem of volition in the execution of thought. Imagination and realist thinking, fundamental aspects to the development of creativity, are placed in a continuum between controlled and non-controlled forms of thinking. This is the voluntary, directed, and controlled against the involuntary, not directed and spontaneous. This constitutes a fundamental aspect in the understanding of the phenomenon of creativity and mental wandering, as is explained by Vygotsky at the end of his lecture:

> I wish to say that the inner connection existent between imagination and realist thought is complemented by a new problem, closely related to *willfulness* or the freedom of human activity in consciousness. The possibilities to act with freedom, that arise in human consciousness, are very closely related to imagination, which is to say, to a such peculiar disposition of consciousness in regard to reality, that arises thanks to the activity of imagination. Three great problems of current psychology come together: the problem of thought, the problem of imagination and the problem of *will* (Vygotsky, 1934a, p. 12).

The Creative Wanderer

Throughout the history of mankind, creativity and innovation have been among the main driving forces of development within the human genome. They have allowed the self-determination of the species and the shaping of the world (Fernández et al., 2019) from multiple disciplines, such as education, psychology, medicine, sports, and arts (Chacón-Araya, 2005; Fernández et al., 2019; Valqui Vidal, 2009). This implies that creativity is an ability with presence in various dimensions of human lives and society (Fernández et al., 2019). Due to this multifaceted nature as a construct – with cognitive, biological, and social components – there is no

consensus in its definition within academic literature (Goldberg, 2018; Edwards-Schachter, 2015).

Creativity is a complex phenomenon that eludes unequivocal approaches and, as of that, any attempt to encompass it as a whole from just one theory is likely doomed to be proven incomprehensible (Kaufman & Glăveanu, 2019; Goldberg, 2018). Thus, it is common to find approaches to creativity from different angles. Some definitions conceptualize it as a process that is susceptible to development over time (Ivet et al., 2009) and that implies a series of steps into the production of an idea or the solving of a problem (Chacón-Araya, 2005). More specifically, it could be understood as a process that involves agency and is oriented toward exploring a potential future scenario that redefines social reality (Awad & Wagoner, 2017).

Other perspectives define creativity as an ability that is transversally present, to a larger or lesser extent, in all of human beings (Casado et al., 2015; Franco, 2006; Ramírez et al., 2017). This notion entails that creativity is deeply rooted and reaches across all of human and society's endeavors (Delgado et al., 2016; Garín et al., 2016) and that it carries the potential for self-enhancement and the transformation of the world (Castillo et al., 2016; Fernández et al., 2019).

Creativity may also be understood as a product, alluding to the fact that it results in something new being created (Chacón-Araya, 2005; Edwards-Schachter, 2015). Some authors focus on the underlying structure of creativity, where theories such as the "Five A's" of Glăveanu (2013), the "Four C's" Beghetto and Kaufman (2013), or the "Multiple Intelligences" of Gardner (1993, 1999) may be found. Meanwhile, other authors have focused on what is needed in order to be creative. Among these theorists, works such as the "Creativity Inversion" from Sternberg and Lubart (1995) and the "Model of Creativity Components" from Amabile (1983, 1996) – later complemented by Amabile and Pratt (2016) – may be mentioned. The previous perspectives share as a common feature the essential role that motivation plays in creativity (Kaufman & Glăveanu, 2019).

There are also authors that enquire into the motives that drive people to be creative, among which the "Systems in Evolution" approach by Gruber and Wallace (1999), the concept of "Flow" by Csikszentmihalyi (1996), or the "Matrix Model" by Unsworth (2001) appear as prominent representatives. These three approaches highlight the relevance of reason as a propellant of creativity and study the way it displays encountering a given situation (Kaufman & Glăveanu, 2019). And so on, different authors adventure into the topic of creativity from other perspectives, such as how an individual creates, how creativity is born of the interaction between people, and how to make a creative work endure the test of time (Kaufman & Glăveanu, 2019).

Taking everything into account, creativity can be conceptualized as a future-oriented, complex, and continuous psychological process. It consists of the construction of meaning – verbal or imaginary – that is aimed at redefining a situation. In other words, creativity involves projecting into the future and opening up possibilities for action and/or creating new social and cultural products (Awad & Wagoner, 2015). However, the creative process is not exempt of external and

internal restraints. Because of this, the resistance that a person exerts into overcoming those constraints is considered fundamental to the creative process.

As a cognitive attribute, creativity can be thought of as a more derivative than a primary type, considering its various forms, temporalities, and levels of manifestation. Adding to this, there are also different domains and problem-solving scenarios within which it can be exerted. As a correlate, a substantial amount of fundamental underlying neural processes involved – in dynamic interactions – speak for the different paths that creativity might traverse. Also, these multiple neural networks account for the varying proportions of cognitive attributes that are activated due to process-specific requirements (Goldberg, 2018).

Research on mind wandering and creativity has rendered somewhat opposite or inconsistent results. On the one hand, there are studies that report an increase in creativity as a result of the augmented unconscious associative processing during mind wandering. Yet, on the other hand, some evidence points to the prejudicial effects of mind wandering during idea generation periods, due to the fact that it takes up valuable cognitive resources much needed for the creative process (Agnoli et al., 2018; Vannucci & Agnoli, 2019).

In this matter, an interesting approach is brought forward by Goldberg (2018), who proposes the process of creativity as a phenomenon of bistable nature. This means that its behavior is characterized by transitions between two states. Neurofunctionally, these two states are anti-correlated and have been referred to as hyperfrontality and hypofrontality, given the activation patterns they express in the prefrontal cortex of the brain.

Hyperfrontality, on the one hand, refers to the instances of executive, deliberated, controlled, task-positive, or goal-directed thought. As the name reveals, the prefrontal cortex is more physiologically active than the rest of the cortex in this state. Within the creativity framework, this process has also been called perspiration or mental focus, accounting for the ability to systematically pursue a logical train of thought and to commit to a sustained effort toward a goal (Goldberg, 2018).

The foundations for a creative idea are laid in a process driven by the frontal lobe in joint activation with various other disparate regions of the posterior association cortex. According to the presented model, this is a labor-intensive and necessary preparatory stage for a creative insight to take place. It is most unlikely that a person who has never pondered a subject matter before will stumble across a truly innovative idea in that domain by accident. It was certainly not by chance that it happened to be a renowned physicist who came up with the groundbreaking theory of relativity or an accomplished artist who conceived a masterpiece like the Sistine Chapel (Goldberg, 2018).

On the other hand, when the central executive network is no longer engaged, the relationship between activity in the prefrontal cortex and the rest of the cortex may be reversed. This is known as hypofrontality and reflects that the default mode network has become active instead. Hypofrontality has been identified as the neural correlate of inspiration in the context of a creative task. Opposite to mental focus, hypofrontality has been linked to mental wandering as an explanation for the sudden

phenomenon whereby an effortless flow of thoughts leads to the solution to a problem or the emergence of a new idea, as if appearing out of nowhere.

In these instances, the activity in the posterior – temporal, parietal, and occipital – regions of the association cortex, which were previously directed by the executive network during hyperfrontality, is no longer subject to deliberate guidance and monitoring. Thus, the activation in these regions – which become anchoring points for subsequent mental wandering episodes – shifts to be driven by the internal connectivity within the posterior cortex. This means that mental wandering becomes somehow constrained following a period of hyperfrontality, and the phenomenon has been homologated to an orchestra of musicians suddenly finding themselves without the conductor in the room, still holding an instrument in their hands, yet free to improvise and experiment with their own tempo and embellishments for the music (Goldberg, 2018).

This process could be interpreted as a residual and divergent pattern of activation in the association cortices, once no longer under control of the executive network. It is this new pattern of activation within the neural circuitry that would allow for the emergence of different – and sometimes novel – perspectives in the scope of a creative task. As of that, hypofrontal activity serves creativity by finding pathways and filling the gaps between initially disjointed neural anchoring points (Goldberg, 2018).

Ultimately, the complex interplay between both phenomena – one deliberate and the other spontaneous – has been argued to be responsible for the success of a creative process in the intraindividual dimension (Vannucci & Agnoli, 2019; Goldberg, 2018). On its own, mind wandering lacks any productive direction and can be seen in certain forms of schizophrenia, along with cases of massive damage to the frontal lobes (Goldberg, 2018). Mind wandering has even been associated negatively with creativity in contexts that lack some form of thought guidance, which has been identified as requisite for the creative insight (Agnoli et al., 2018; Vannucci & Agnoli, 2019). Yet, on the other hand, the presented framework implies a major functional and evolutionary role of mind wandering and most likely other forms of spontaneous thought in everyday life (Goldberg, 2018; Fox & Beaty, 2019; Vannucci & Agnoli, 2019).

Phenomenologically, intentional or situated mental wandering can be seen as a positive predictor of creativity due to the fact that it increases the capacity to describe inner experiences with words, which has been identified as a core feature to the creative effort. That is to say, that deliberately wandering might help describe the external world with the added complexity of language, thus internally enriching the external. (Agnoli et al., 2018; Vannucci & Agnoli, 2019).

In review, it is interesting to note that the content and intrinsic nature of a mind wandering episode are the dimensions that have captured most of the attention of the scientific community. However, one of the most definitive answers to the long-sought resolution regarding the psychological implications of the phenomenon could lie far beyond that matter. Instead, the answer might simply be found in the context surrounding the mental process itself.

Resistance: Barriers Within the Psychological and Cultural Dimensions

The world is characterized by the dividing presence of abundant physical and psychological barriers. Yet, no matter how rigid these barriers might be, they will always be subject to the possibility of being destroyed, transformed, or negotiated (Awad & Wagoner, 2017). In this regard, human beings have been defined by their capacity to actively shape their environments, creating or granting new meanings through forms of resistance (Chaudhary et al., 2017).

From the perspective of social psychology, resistance is understood as an exercise of power in which an individual or group opposes something external, be it an object, idea, image, person, or other groups (Chaudhary et al., 2017; Molina Valencia, 2005). This is a vital and functional strategy to any living organism (Chaudhary et al., 2017), which aids in preventing the naturalization of dominant bonds and power asymmetries through spaces of freedom (Molina Valencia, 2005). It allows the building or emergence of new forms of thinking, feeling, acting, and living with others (Chaudhary et al., 2017).

However, in spite of the possibilities for improvement that arise through the exercise of resistance, it is often considered to be something detrimental, immature, and irrational. It has been, for example, stereotypically homologated to defiant childish behavior (Chaudhary et al., 2017). A clear example of the expression of resistance can be found in street art, specifically in the form of wall art and graffities. These expressions can be interpreted as tools that manifest a form of opposition or challenge to traditional social structures through symbolisms, which in this case are meant to mobilize pedestrians into a cause (Awad et al., 2017; Awad & Wagoner, 2017). The artistic manifestations are usually situated in a particular temporal context that is related to a controversial issue and are oriented toward future imaginaries (Awad et al., 2017). Thus, street art can be proposed as an instrument that is oriented to the opening of spaces for thought and social introspection. In this sense, as an instrument that challenges the status quo and promotes social change through creative activism (Awad & Wagoner, 2017).

Nevertheless, the notion of resistance implies multiple meanings that may also be interpreted as the attitude toward keeping certain aspects of reality intact or whole, that is to say, the resistance to change itself (Briñol et al., 2008). Simply put, a known example of this would be the attributed connotation of the term resistance in classical psychoanalytic theory, where it is interpreted as the actions and words that obstruct the analysis and treatment of the patient (Vildoso, 2019). Consequently, resistance is viewed as a phenomenon that articulates both the preservation and also the change of meanings within and between people. Thus, it is present both in the societal and individual levels of analysis (Awad et al., 2017; Awad & Wagoner, 2017; Chaudhary et al., 2017).

Mind Wandering, Creativity, and Resistance

It used to be thought that a wandering mind was an unhappy mind, due to the notion that having task-unrelated thoughts carried an emotional toll upon the person experiencing them (Killingsworth & Gilbert, 2010). Additionally, mind wandering has been repeatedly associated with low task performance, decreases in executive control and attention, and lower working memory capacity (Agnoli et al., 2018). However, a growing body of research has recently found that mind wandering is also a valuable cognitive asset and has reported numerous beneficial consequences, such as future planning and simulation of future events (Vannucci & Agnoli, 2019), keeping individuals on track of their most relevant goals and also contributing to the resolve of pressing concerns in people's lives (Agnoli et al., 2018).

If resistance is understood as a change-enabling phenomenon that is present within individuals (Awad et al., 2017; Awad & Wagoner, 2017; Chaudhary et al., 2017), that is to say, as an intrapsychic capacity that is oriented toward personal change, it is possible to interpret mental wandering as a phenomenon that allows the occurrence of this type of resistance. When thought is oriented internally and focused on the individual's goals, mind wandering has the ability to enhance self-awareness. Consequently, this aids in the process of personal growth, as thoughts navigate around goals and intrinsic motivations (Batalloso, 2019). These can be proposed as a first type of individual resistance to the person's own psychological "status quo," as internalized and crystalized in the inner structure of the mind (Vygotsky, 1934b). On the other hand, inquiries into one's own mind to find new perspectives and address problems toward their resolution can also be thought of as a form of personal development that is intimately related to the creative potential of the person in the emotional domain (Alessandroni, 2017; Fox & Beaty, 2019). In this type of effort, however, a second form of intrapsychic resistance is manifested. This phenomenon references the resistance to change as the main psychological force that acts against the achievement of personal growth.

Conclusion

There are a number of relevant conclusions that can be drawn from this chapter's review in regard to the different domains of thought and current research branches. For a start, it has now become evident how the task-oriented experimental paradigm has hampered a comprehensive understanding of the mind wandering phenomenon, tainting its definition, understating its functional role in consciousness, and oversizing its negative psychological consequences until recently (Mills et al., 2018; Fox et al., 2018; Goldberg, 2018; Andrews-Hanna et al., 2017; Irving, 2016; Vygotsky, 1934b).

As has been argued, the notion of mind wandering as task-unrelated thought fails to capture the phenomenon's most relevant features, such as dynamics and intentionality. In this matter, research that has articulated mind wandering along

with other phenomena of thought, such as rumination and creativity, has been crucial in the consolidation of an integrative framework with a more stable and accurate definition (Andrews-Hanna et al., 2017). Adding to this, findings concerning the nuances and fundamental aspects of mind wandering have also contributed to moving past the stereotyped notion of the phenomenon. Thus, it is currently possible to differentiate the phenomenology of mental wandering from other factors that exert a negative influence over its contents and outcomes. One of the most controversial factors in question has been the psychological symptomatology of a person (Fox et al., 2018).

Closely related to the trajectory of the definition of mind wandering during the last couple of decades, one of the most consistent, relevant, and transversal agreements across theories stands on the existence of a control dimension of thought. This dimension constitutes a continuum that ranges from spontaneous or self-generated on one end to deliberate or executive on the other. Virtually every phenomenon of thought has been analyzed and conceptualized as standing a ground or moving through this dimension. This notion has resulted in a key construct to compare and differentiate between phenomena of thought, given their specific constitutional dynamics and their complementary or interdependent nature (Goldberg, 2018; Andrews-Hanna et al., 2017).

In the cultural-historical tradition, parallel constructs have been known as egocentric or solipsist thought on the one hand and social or realist thought on the other (Vygotsky, 1934b).

Within developmental psychology, it has been stated that this continuum of thought is consolidated through maturation and social experience. From the onset of life, a child's mind is predominantly wandering in nature, with very little episodes of task-oriented actions. It isn't until exposure to socially demanding scenarios that kids start to develop a sense of realist or social thought (Piaget, 1923). In this sense, ontogenetically speaking, mind wandering and spontaneous thought in adults could even be understood as a foundational form of thinking. This type of thought might serve an exploratory role in childhood development that then translates into the adult brain in a similar quality.

It might even be hypothesized a step further in that the education system, instead of harnessing the adaptive potential of spontaneous thinking for superior mental processes such as creativity and flexibility, consistently undermines and punishes off-task thinking. This, in an ill-conceived effort to subjugate attention into absolute obedience. This might as well be one of the main reasons why mind wandering, as a form of spontaneous thought, has been referred to as a source of discomfort by many adults in empirical studies (Killingsworth & Gilbert, 2010). As a consequence of the task-oriented educational paradigm, adults end up lacking the strategies to effectively manage and seize the benefits of this inherent aspect of psychological experience. Traditional educational systems have been known for centering more on results than on individual processes, therefore neglecting the function that self-generated thoughts serve to the person experiencing them and the opportunity to employ them to an educational advantage. This, due to the fact that the focus of attention is deviated from external tasks during such episodes, which has been considered as a

nuisance and a defiance against learning itself. Contrary to this perspective, educational development in later years has placed emphasis on the notion that the purpose of education goes beyond the plain transmission of information reflected in most evaluation methodologies. Instead, educational institutions are starting to be recognized as guarantors in the development of key skills for the XXI century, where creativity and innovation are highlighted (Reimers y Chung, 2016).

The phenomenon of mental wandering has emerged as a subject of study within a task oriented cultural context. In an educational and social system where unguided thinking is seen as an obstacle to learning that has to be fought against in the classroom. In a system where its functional nature has been consistently overlooked and undervalued, and where narrow focus is praised and perceived as the most adaptive and desirable trait. Notwithstanding, research has recently shown just how common and pervasive the experience of mental wandering really is on a day-to-day basis—present while performing all different kinds of other "tasks". Thus, it is becoming ever clearer that mind wandering should be taken into account and put to the service of the learning process.

This change implies a broadening in the understanding of the phenomenon, to more than a distraction and an obstacle. Rather than off task, it may be better conceived as a shift from an external to an internal task, and it might open the window to a yet unexplored dimension of the learning process inside the classroom. Mind wandering could be an act of resistance to the status quo in formal educational processes, and this resistance may prove to expand the limits of learning and creativity. Accounting for and incorporating mental wandering in the learning process might lead to different benefits to the academic experience inside the classroom.

As has been stated, mind wandering is an affective experience and should be seen as a naturally occurring and intermittent human phenomenon. As such, it should be put to the service of learning, development, and cognitive transformation. Future educational processes might benefit from leaning away from a model of linear knowledge transfer and steering towards integral development approaches that comprise all aspects of human experience. One of the first steps in this transition involves addressing and knocking down negative stigmas and connotations commonly associated with the mind wandering phenomenon. This would enable new educational strategies to be thought, developed, tested and implemented in the classroom.

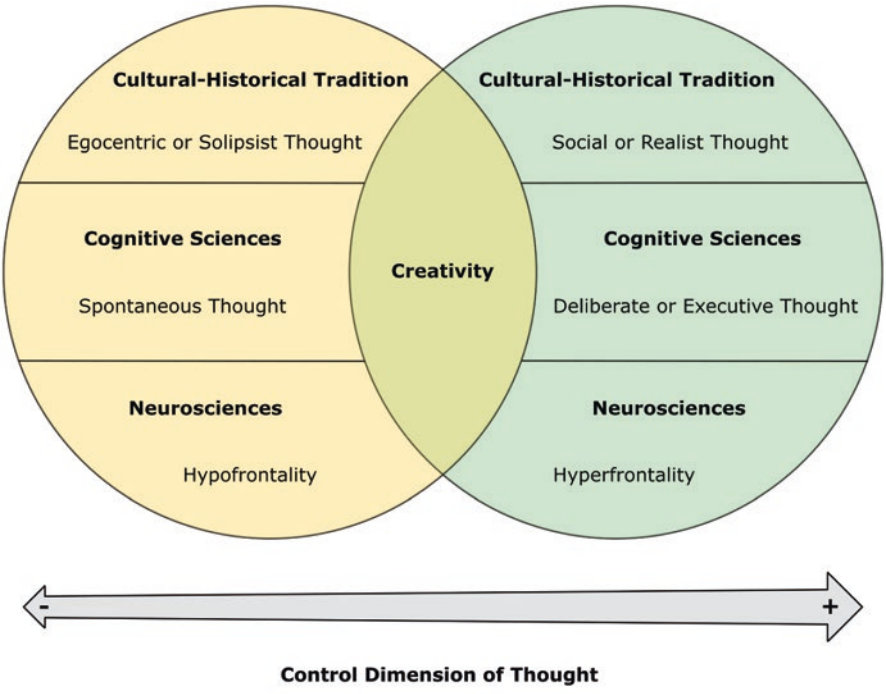
For one, mind wandering may prove to be a useful metric—a gauge of student engagement—in the assessment of educational practices. In this sense, mind wandering would act as a measure of the phenomenon of resistance in the educational context. A second field of intervention could be associated with strategies aimed at promoting the development of skills in the self-regulation and emotional domain. Perhaps improving the student's own understanding of their mental processes could help reduce anxiety over their capabilities to focus and over what is expected of them, and thus lead to a more efficient management of their efforts in the learning process. Finally, mind wandering based interventions and exercise programs might promote the development of abilities where the phenomenon plays a constructive role, such as creativity.

With the advent of massive online or virtual education, it is becoming increasingly important to think about the mind wandering phenomenon in various

educational settings. Nowadays, students find themselves in different contexts with unforeseen educational challenges. In this scenario, how to best deal with mind wandering through pedagogical tools and strategies—in order to serve the acquisition of knowledge and the development of new functions and skills—appears to be the question that will guide future research in mind wandering and education.

Addressing the topic of creativity, a remarkable convergence has to be mentioned in its understanding between the cultural-historical's perspective and the modern cognitive sciences and neuroscience's perspective. It is surprising that, even in spite of their epistemological differences, the two takes on creativity share a core argument. Both theories consider the creative process to be an intermediate or integrative psychological instance between the spontaneous or egocentric and deliberate or social polarities of thought. In other words, a complex and interactive process of connection and disconnection from the social or external context. This, however, without clarifying the magnitude that each of the psychological states plays in the creative phenomenon itself, given its multiplicity and derivative nature.

Figure 13.2 shows a parallel of the different theories' nomenclatures and how they all reflect a core argument regarding the relationship of creativity to the control dimension of thought.



Note. Self elaboration.

Fig. 13.2 Transversal theory convergence in creativity research

What is utmost impressive about this is how findings in modern neuroscience match the ideas already developed in the cultural-historical tradition. In other words, neuroscientific evidence has begun corroborating ideas first proposed by Vygotsky almost a century ago.

Complementary to the conclusions on creativity, the notion of imagination could be understood as a morphological dimension of thought, for it references how thought is presented in experience and the quality of the images that constitute consciousness (Fossa et al., 2018a). Imagination implies a process of meditation about the world and the self, all within the psychological space of a person's mind. It is another vivid expression of the process of internalization described by Vygotsky (1934b). What is especially interesting to this concept is that it unravels yet another dimension to the creative process, for it mediates in its occurrence. Nonetheless, in spite of its relevance, this morphological dimension has been paid little attention by the cognitive sciences and neurosciences in current research efforts.

It is of most importance to understand thought as a phenomenon simultaneously cognitive and affective in its foundations. In this sense, and contrary to cognitive literature's preconceptions, the affective quality of all thought phenomena can't be overstated. As has been extensively reviewed, spontaneous thought and mind wandering constitute processes indented and inherent to human psychic activity. In this topic, the evidence is clear on the predominance of affective content during episodes of self-generated thoughts. These types of thoughts present and express the affective dimension of human experience, both in its positive and functional manifestations, such as creativity, and also in the expression of conflict and mental illness. When addressing deliberate or executive thought, however, the evidence is dimmer as to the relationship to affectivity. In this matter, the present chapter reveals a key point in the analysis of volition and willfulness. It is concluded, that in its volitional nature, executive or deliberate thought undeniably carries an affective component that must be taken into account as well – an affective component that is substantiated upon the notion of indivisibility between affectivity and volition in human experience, as described by Vygotsky in his theory of a volitional affective sphere of consciousness (Vygotsky, 1934b).

Closely related, it is relevant to reflect upon the relation between mind wandering and the individual's whole psychological organization. The notion of mental wandering has generally been stripped of any relationship to other psychological processes. It has not yet been understood as part of a holistic or whole psychological organization. Mind wandering is a complex cognitive-affective phenomenon in constant relationship to other functions of the psyche, knowingly, volition, imagination, thought, language, memory, affectivity, perception (inner and outer), and creativity. This is what Vygotsky (1934b) termed inter-functional connections.

The referred notion of inter-functional connections also raises the fundamental question of how different psychological functions are organized in experience. If such an articulating role indeed exists, it could be argued that affectivity, as a phenomenon of its own, is the instance situated in the space of interaction between

different mental processes. In its generative nature, affects are the engine at the very base of consciousness and mediate in the occurrence and the interaction between psychological functions (Vygotsky, 1934b).

Consciousness should be studied as an integrative unit instead of as vessel containing isolated cognitive phenomena. In this sense, mind wandering is a good example of how a collection of psychological processes and systems in dynamic interactions – within an affective matrix – converge into the vividness of a single experience. As such, mental wandering is an expression of consciousness in its full complexity. This type of perspective is greatly missed in modern literature on the topic.

Another important remark to be made is the relationship to temporality. Time being irreversible and consciousness flowing in a permanent steam, or "stream of consciousness" (James, 1890), the question about the functional role of mental wandering is still in order. Whether this function is to serve as a game, as a resting state, as a self-contemplation strategy, or as a preparation or mental "rehearsal" that transgresses the temporal barrier into the future. Evolutionarily, the first assumption that comes to mind is that as a phenomenon inherent to consciousness, it must serve a purpose.

But are there purposeless aspects to consciousness? Or perhaps has the purpose yet to be encompassed into a less explored function of mental activity? Could it be that mind wandering is really just a byproduct of other mental processes or the repercussion of a malfunction in the cognitive machinery? Or, from another perspective, are we in a moment in history where evolution needs to catch up with society's advances and cultural dynamics?

An interesting question to be asked at this point is: What would the consequences of being deprived of mental wandering be? Would individuals be in a socially instructed continual task-positive frenzy? It might as well be that, without wandering, fundamental individual and social processes such as resistance and creativity could cease to exist.

Whatever the case, the importance of the question into the role of mind wandering and spontaneous thought in all domains of knowledge cannot be overlooked. Whether in the individual level of consciousness or in social dynamics and culture, a comprehensive understanding of the phenomenon must undoubtedly take its function into account.

In synthesis, there is literature over the last decade that proposes a relationship between mind wandering and a decrease in subjective well-being or satisfaction with the individual's own life (Poerio et al. 2013; Ruby et al. 2013; Smallwood & O'Connor 2011; Ottaviani & Couyoumdjian 2013). This evidence is congruent with the findings by Killingsworth and Gilbert (2010). However, other works have recently established a nexus between the phenomenon of mind wandering and future thinking, planning, imagination, and the creative process, raising new fundamental questions into the phenomenon's role in regard to other phenomena of thought and consciousness as a whole (Mooneyham & Schooler, 2013).

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Chapter 14
Conclusion. Toward a Generative-Systemic Perspective: A Critical View on the Mind Wandering Arena

Luca Tateo and Nadia Dario

Our joint inquiry effort into mind-wandering (MW) started because we were fascinated by the human capability to generate worlds of possibilities (Dario & Tateo, 2020a, b; Tateo, 2020).

Imaginative processes, generativity, and creativity are ubiquitous and peculiar human capabilities that lure anyone interested in human development, learning, and culture. Very soon during our inquiry, we realized that the generative capability of the human mind was somehow problematic for an idea of schooling and learning which is based on the attention-control-account paradigm. We identified MW as a specimen of such a tension. MW somehow represents the arena in which all the stereotypical ideas about cognition, thinking, and learning that cross psychology, education, and neurosciences become visible and shape the theory. The inquiry about neurologic functioning should not lead to a biological reductionism. Some contributors to this volume pay a lot of attention to the biological dispositive and its functioning. In this sense, the exploration of MW shows that the *bios* must always be in dialogue with the *anthropos*, involving those processes that give rise to the multiform and to the transformation of oneself (Galzigna & Basso, 2008). Hence, there is a need to provide an overview of the dialectics between the conceptions of MW in the current interdisciplinary research, with a particular focus on learning and education. Indeed, by cultivating a dialogue between different perspectives on MW, we want to stress the importance of subjectivity and identification, relational empathy, and affective relationships.

In the definition of MW as task-unrelated and self-generated thought that can cause attention decoupling, for instance, during a school activity, one can see an old idea of learning as retention of information transferred from a source. The student

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should be focused on one single task at a time and receive and retain information from a teacher, to remember it and perform it correctly later during an assessment. Any deviation from this perception-execution cycle is understood as a distraction and waste of cognitive resources. Likewise, the idea of decoupling and the sharp distinction between hetero and self-generated thoughts reproduces a stereotypical idea of a representational nature of thoughts generated by external stimuli as clearly distinguished by those thoughts who have no referent in the real external world. Finally, the works collected in this volume accept almost unanimously the distinction between spontaneous and intentional forms of MW. Goozli (this volume, Chap. 6) and Ergas (this volume, Chap. 9) elegantly question such a distinction by reflecting upon the relationship between intentionality, agency, and consciousness. The nature of MW seems to lay at the ground of our idea about the nature that "I" as more or less unitary or stable instance that governs the individual. Indeed, MW is also the arena where different conceptions of the Self compete. Is the sense of Self an emerging property of neural networks interaction growing out of preceptor-effector cycles? Is rather the Self an illusionary product of our striving for unachieved desires and unfulfilled regrets? Alternatively, is it the product of a narrative that links experiences with expectations? One can find these alternative ontologies as the more or less explicit starting point for each of the theories about MW presented in this volume. MW seems to be either the product of a misalignment between different brain modules and the environment – the dissolution of a scattered "I" – or the playground in which alternatives are explored, plans are formulated, and memories are reworked (the place in which "I" is in full control). It roughly corresponds to the current distinction between spontaneous and intentional MW. Whether or not we are talking about different phenomena or about two types of MW is an open question. Yet, *how we* talk about MW reveals something about our current conception of the human being.

SART and the Neoliberal Self

One of the common instruments used in the experimental study of MW is the Sustained Attention to Response Task (SART) (Jackson & Balota, 2012; Smallwood et al., 2004). The task is used in the study of different cognitive phenomena, such as working memory, attention, inhibitory control, and mind wandering.[1]

The task in itself is particularly interesting. It consists of a black computer screen on which a series of digits (between 1 and 12) are presented in the center for 250 milliseconds, interspersed with a separator (Fig. 14.1). The task consists of pressing the space bar of the computer every time a digit appears in the center of the screen. Only when the digit presented is "3" that the subject has to avoid pressing the

[1] See https://www.youtube.com/watch?v=OjvW4q0v5AI&t=113s for an example of the running software.

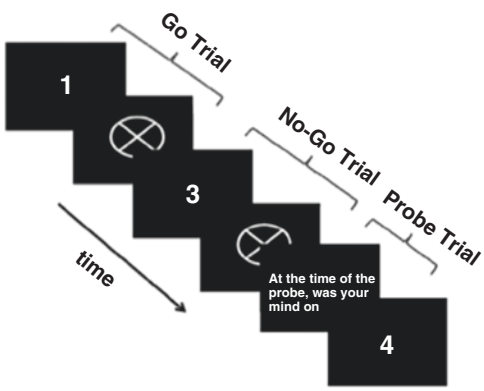

Fig. 14.1 An example of START screen sequence

spacebar. The overall task duration is 20 minutes, starting with a practice block of digits followed by four rounds of 5 minutes each. In total, the subject is presented with 1040 trials containing 72 "targets," randomly distributed.

After each block, two probe questions are presented: "Where was your attention focused during this block of trials?" "How aware were you of where your attention was during this block of trials? The idea is that the subject must be focused on the task of "inhibiting" the habitual response (pressing the spacebar).

Now, we would like to invite you to figure out yourself as SART subject, participating in an experiment. At the beginning, you will be given the following task instructions: "Please, sit comfortably approximately 57 cm from your computer display and turn off all software programs that may be running in the background. In this task, you will see a series of numbers appear on the screen, separated by the "⊗". Your job is to push <SPACE> when you see any number EXCEPT for the number 3. When you see the number 3, do nothing. We want to give you equal emphasis to accuracy and speed during this task."

Imagine yourself starting the practice block (160 trials with 8 probes). You want to do well and maybe please the experimenter. You may even want to look "smart" and diligent during the task. You feel evaluated of course. You try to understand the functioning and the logic of the task. Then, the test begins and you will go through 1040 trials in four blocks with 72 random "targets." At the beginning, your attention is focused on the screen, trying to react accurately and rapidly to the digits appearing on the black background. However, it is not difficult to imagine that after some trials you will start thinking how does the task "really" work. "Is there any hidden logic behind the order of the digits?" "Can I improve my performance by predicting and anticipating the next digit?"

You may start exploring different strategies mentally. *Are* you mind-wandering now? Is it spontaneous or intentional? Is your thought related or unrelated to the task? Where is your attention directed? To what extent will your performance be affected? What if MW *is part* of our way to solve the task? Maybe, after hundreds of trials, boredom of the task can emerge, and you may start thinking about "something else," which researchers find regularly. Then, you may think about something

more or less loosely associated with the digits, to the black screen, etc. What is the difference between this latter MW and the former type? What happens if the experimental subject is younger and very familiar with digital devices and social media? How easily her mind will wander after a few minutes before a black screen? How much will the familiarity with some tools and the personal background affect the meaning and understanding of the task?

It is not by coincidence that the SART task is so simple to result artificial and far from most real-life experiences, except maybe the most repetitive work-chain actions of Fordism factories. It may be that the SART, which is itself designed to require a focused attention, generates a MW in order to solve the task. If one restricts the definition of MW to "task unrelated thought," then we must admit that a wide range of phenomena that we consider MW experiences are left out. Yet, what does "task unrelated" mean? In the SART example, as well as in the discussion by Goozli (2022), one can see how our experience is more complex than a single task-off task alternation. Of course, when it comes to specific complex tasks, such as flying an airplane, operating a dangerous machinery, or performing a surgery (Galéra et al., 2012; Smallwood et al., 2011), *too much* MW is a threat to survival. However, the task-off task distinction is hard to apply even to the simplest activity such as the SART test.

The idea of a single-minded and single-task focused performative self is the outcome of a "neoliberal self" approach to learning (Miller, 2016). The neoliberal self, focused on the here-and-now full performative, controlling, and productive thinking, is transferred to the field of teaching/learning with the effect of making MW experiences a deviation from the norm. Similarly, the structure of the academic curricula in higher education after the Bologna Process tend to set clear and straight goals, tasks, and achievements in a defined timeframe. Any subject-wandering, curriculum assemblage, curiosity, and multidisciplinary exploration is considered a deviation from the path. The subject must find her purpose, fulfillment, and meaning (Bendassolli & Tateo, 2018) in a rigid framework of performativity. "Wandering" is neither an attribute of productive life nor a privilege of "leisure time" that is also characterized by a series of tasks to achieve well-being (meditation, fitness, etc.) in which MW can interfere. The idea of a passive attitude of the mind that wanders in contrast to mental actions, like reasoning and planning, dates back to Hobbes and the birth of capitalism itself (Irving & Glasser, 2020), and it is today reinforced by the idea of "learning by doing," which also sees the passive wandering of mind as a waste of resources. One must go back earlier in time to find a different appreciation of the time spent "doing nothing."

Mind-Wandering as a Method

One of the recurrent common places about MW is that such a ubiquitous and frequent phenomenon must be survived for its evolutionary value. If during the evolutionary process human species has preserved MW, it should have provided some

advantage to the survival of the species. This is not a pointless argument in favor of MW. Indeed, humankind has changed for many reasons but has also evolved in a cultural sense. Thus, our main evolutionary feature is the capability of building cultural conditions that promote or inhibit inherited characteristics. It would be the same to say that human species practice violence because it has some evolutionary advantage. Shall we then simply accept violence in our societies forever? Shall we not pursue the banning of wars and weapons among human beings? Hence, while trying to understand the origins and the characteristics of the MW process, the interesting questions to ask are: "under which circumstances" and "for what purpose" MW can be desirable/undesirable, and "how can it be purposefully cultivated and educated"?

Is one really "doing nothing" or "being off-task" when the mind wanders (Metzinger, 2018)? There was a time in which "doing nothing" was a privilege of the ruling classes and an integral part of citizenship (Arendt, 2013). The Greek concept of *schole* and its Latin correspondent *otium* were the hallmark of free citizenship. The opposite condition, being tied down to a mundane task – the negation of *otium*, that is, the *nec-otium* – was proper of lower classes and slaves. This was one of the main points of attack by the Christian theology to the "pagan" philosophy and ethics. Being idle and wandering in the agora paved the way to vice and sin. The good Christian is the believer who does not waste her life in idleness and pleasures rather is focused on using fruitfully her time on Earth trying to gain her way to afterlife. To do so, the meditative technique that Christians called prayer and the focus on work tasks were the best ways: *ora et labora*. Western educational systems are largely based on the Christian monastic model of education; thus, idleness and mind-wandering have always been seen in a negative way. The wandering mind is neither directly "observable" nor "punishable" by a supervisor. Any kind of sinful thoughts can emerge in a wandering mind already told us by Saint Augustine, whose conversion on the contrary was a huge process of mind-wandering, actually. He wrote:

> "Afterward I began to laugh—at first in my sleep, then when waking. For this I have been told about myself and I believe it—though I cannot remember it—for I see the same things in other infants. Then, little by little, I realized where I was and wished to tell my wishes to those who might satisfy them, but I could not! For my wants were inside me, and they were outside, and they could not by any power of theirs come into my soul" (Augustine, 1955, p. 14).

MW is presented as an attention problem, but it has a clear ethical value (Irving & Glasser, 2020; Thompson, 2005). When the Christian-based education meets the capitalistic value-system based on efficiency and productivity of labor, there is no escape or salvation for MW.

Does neoliberal value-system sanctions imaginative thinking altogether? Certainly not. As several authors in this volume point out, creativity is a positive value in contemporary societies. Thus, imagining is allowed to the extent that it leads to "innovation" and "creativity" with a purpose. Generative thinking is admitted in education unless it is accountable and visible.

Miriam McCormick (2020) had the intuition of the revolutionary character of purposeless and unaccountable MW:

> "there is, or ought to be, a domain of the mind that is completely free of normative assessment, where you are safe to let your thoughts and images go wherever they take you without concern that you are doing anything wrong" (p.270).

The phenomenon of MW is usually provided with a negative value in the narrative of a struggle for the mind's limited cognitive resources. Thus, who must prevail? The idle production of self-generated, task-unrelated, and inner-focused thoughts, or the useful and efficient production of task-focused and accountable thoughts? One cannot sanction others' mind-wandering content; the teacher can only detect it and try to foster the internalization of a self-inspector in every student with the task of inhibiting any thought which is not task-related (McCormick, 2020).

What can one learn from the chapters collected in this volume about the liberatory and revolutionary role of MW? What can be the consequences of thinking about MW as a non-normative form of thought? What can education obtain from the cultivation of MW as a *method*?

Conclusion: Toward a Pedagogy of "Trans"

Within the complex network mind-brain-learning-nature-culture-training, at the junction between *bio-educational* and *anthropo-formative* perspectives, pedagogy cannot be limited to the conditions of *educability* (the child learns only if attentive) but must focus on the whole of human development (one does not learn only from school lecturing and testing). It is time to overcome the idea of cognitive educability defined by the constraints of biological potential and the influences of environmental patterns. We need an education that supports developmental processes of transformation, transition, and transaction that characterize the anthropos. We need a vision of human beings as an autonomous entity, able to be self-representing (Foucault, 1990; Moscovici, 1972). Across evolution, humans developed freedom and motivation, overcoming the organic and instinctual equipment. Indeed, humans acted on their environment, very often creating it. In this sense, we need a pedagogy that looks at the "trans," that is, the human subject's ability to pass from one condition to another, from one change to another, from one belonging to another. It is not only necessary living in the existence *here-and-now* but also projecting oneself ahead and postulating alternative possible existences. By discussing the different understandings to MW and their educational implications, we have tried to open a new path of potential theoretical and methodological discussion. Indeed, we are tempted to imagine that MW is one of the higher mental processes through which human beings can attain a free space of potentiality: one of the ways we explore the transcendence that gives meaning to our existence.

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