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Creativity and Innovation
Everyday Dynamics and Practice

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CHAPTER 1

Introduction: Creativity, Innovation and Everyday Dynamics

Abstract This introductory chapter frames the background to our study of creativity and innovation, which consists of intersecting disciplinary developments and historical conditions. This chapter introduces the subject of creativity as studied by some prominent psychologists over the past century and links it to more contemporary conceptualisations, including its economic and cultural manifestation within the discourse of the creative industries. The chapter sets the scene for the chapters that follow by focusing on the importance of human connectedness in understanding creativity and the everyday practice of innovation. We present the argument that 'everyday dynamics', as a shorthand for the ethical dynamism of creativity that depends on and harnesses human connectedness, can become a mechanism for assembling a new form of reality to address the problematic complexities of our world.

Keyword Creativity · Innovation · Everyday dynamics · Innovative practice · Ordinary creativity

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Creativity (Re)Introduced

> The real source of wealth and capital in this new era is not material things. It is the human mind, the human spirit, the human imagination, and our faith in the future
> —Steve Forbes (in Siebold, 2010: Ch. 12).

Creativity has been of great interest to human beings for a very long time. It has been studied for by psychologists and social scientists over the past century, and while always a factor in human life, tapered off as a subject of keen scholarly inquiry until the late 1990s. This coincided with the advent of the technological age, most prominently demonstrated by the rise of global Internet access and digital business transactions. Interest in the discourse of creativity was heavily boosted by the unveiling of the concept of 'creative industries' at that time. The concept of the 'creative industries' has its formal origins in the United Kingdom in 1998, as one aspect of British Prime Minister Tony Blair's economic revitalisation strategy, captured in the popular term 'Cool Britannia' (Flew 2012). Following Britain, many developed and economically-aspirational countries around the world—including, in the Indo-Pacific region, Australia and Singapore, just to name a couple—have adopted 'creative industries' in their public policy nomenclature to describe and promote their arts and cultural sectors (Hesmondhalgh 2002; Howkins 2001).

Even though government leaders and bureaucrats viewed the creative industries as a source of wealth and capital, in terms of how creative businesses can help to boost productivity and economic gains, the concept sparked the rise of creativity as a cultural discourse (Lee, 2007). As media and creative industries scholar Terry Flew declared, creativity has become 'both big business and a lot of different things to different people' (2003: 90). The upsurge of interest in the area since the late 1990s had stemmed from the pace and extent of take-up of the notion of 'creativity' within government, policy and corporate circles (O'Keefe 2004: 34; Flew 2004: 161).

When Richard Florida, a Canadian business school professor, arrived with his 2002 best-selling book *The Rise of the Creative Class*, interest in what could be described as 'creativity as a new form of humanism' had skyrocketed. Florida's key argument is that economic growth is a

by-product of creativity and that the nurturing of what he calls the 'creative class' is the key determinant of an economy's success or failure (Florida, 2002). Florida puts forth the case that creativity flourishes best in places and times marked by four characteristics: 'domain activity, intellectual receptiveness, ethnic diversity, [and] political openness' (Florida 2002: 35). Florida famously championed the promotion of tolerance, alongside technology and talent, collectively known as the '3Ts', as keys to harnessing creativity (Florida 2002: Chapter 14). Florida specifically cites 'bohemianism' and 'homosexuality' as two non-conformist cultural practices that test the limits of tolerance of a society, and suggests that creativity presents itself in intellectuals or individuals within the 'creative class' who are motivated, even empowered, by such diversities (Lee, 2007).

Although widely employed by many people, the term and discourse of creativity remains a nebulous concept, not unlike the term and notion of 'culture', which Raymond Williams (1976) describes as one of the most complex and complicated in the English language. Creativity is even described by experimental psychologists Teresa Amabile and Elizabeth Tighe, both of whom have conducted extensive research on creativity, as 'too ill-defined a quality to be studied properly' because it is a vacuous concept that defies ordinary thinking (1993: 8). Creativity could thus be said to be 'extraordinary' in that in order for to be considered creative, a product or response "must be different from what has been done before" (Amabile and Tighe 1993: 9). Herein lies the most widely accepted conceptual definition of creativity: "the ability to invent and develop new and original ideas" (adopted by popular dictionaries such as the *Collins Cobuild English Language Dictionary* (1993), and virtually in all search engine sites).

Yet creativity is more than just a new idea or invention, since not every original idea can be construed as creative. According to Margaret Boden, a professor of cognitive science, creativity should also be 'valuable' both aesthetically and pragmatically (Boden 2004: 10). In other words, creativity must be appropriately applied to a situation that would be well-received by its audience. This is referred to as creativity that is 'domain-relevant', the first of three basic components of creativity advanced by Amabile and Tighe (1993: 14). While the first marker of creativity has to do with the originality-and-appropriateness of an idea, solution or product, the second relates to the level of passion for the

creative activity (Lee 2007). Amabile calls such passion 'intrinsic motivation' or the ability to engage with a creative activity due to genuine fervour for a task (Amabile 1993). In essence, the principle of intrinsic motivation is that:

> People will be most creative when they feel motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself (intrinsic motivation), and not by external pressures (extrinsic motivation).... [and] people will achieve the level of deep task involvement that is essential to creativity. (Amabile and Tighe 1993: 16)

Although it may be possible for intrinsic motivation to coexist somewhat with extrinsic motivation, one tends to emerge as the primary driving force for a given task (Lee, 2007: 50–51). Based on Amabile and Tighe's (1993) principle, the task undertaken with intrinsic motivation tends to be more creative as a result. The third element of creativity relates more to the socio-cultural environment within which the creative person operates. Amabile and Tighe (1993) describe this as 'creativity-relevant skills' which include cognitive and personal styles that tend towards independence, risk-taking, innovation, non-conformism and tolerance for ambiguity and diversity, all of which are seen as 'conducive to generating novel and useful ideas in any domain' (Amabile and Tighe 1993: 15).

All the above points to a need to understand creativity as a natural, perhaps evolutionary (in the broadest sense of the term), result of human discourse, exchanges and networking. The corollary is that human capacity to be creative must have had an ancient history. In truth, the evidences are plentiful. Recent archaeological research shows that human creativity, evidenced by art and technological invention, existed centuries ago. According to Pringle, "our power of innovation did not burst into existence fully formed late in our evolutionary history but rather gained steam over hundreds of thousands of years" (2014, 6). According to him, thousands of years ago in Africa, and also in Europe, creativity and innovation were lit by a web of 'biological and social factors' (ibid.). This is when human groups were large enough to create social networks that built on other people's ideas. Larger groups increase the chances of good ideas emerging, foster sharing with others and spur creativity.

The introduction of agriculture and sedentary lifestyles, and the formation of cities, gave people more time to think, and more free time led to

the expansion of language and imagination, evident, for example, in Akkadian poetry, such as the Gilgamesh Epic (2100 BC) (Pringle, 2014). We now live in a digitally connected age that has increased our chances of connecting with others and finding the information we need to improve our ideas. We have never been more connected and willing to share and collaborate, so it is no coincidence that the rate of creativity and innovation over the past three decades is unprecedented in history. Yet simply being connected does not explain how creativity arises from collaboration, a vital question in an era of social media and rapid social change (Nussbaum 2013: 27). Whereas cognitive psychology and neuroscience have shown that creativity is not only for the gifted few, sociocultural perspectives shed light on "how we must act in a social context to be creative" (Nussbaum 2013, 27).

While this chapter, and indeed this book, draws a great deal from both early and popular psychological studies on the subject, we argue concomitantly that sociocultural approaches also offer valuable insights into creativity and innovation. The theme that will recur throughout this book is that human connectedness—what we refer to as *everyday dynamics*—accompanied by the practical acts of doing through experimentations and inventions is the key to stimulating creativity. From an organisational perspective, realising innovative potential hinges on the ability to encourage creativity and to "make decisions and choices on the basis of being well-prepared, informed and connected" (Dodgson and Gann 2010, 117). David Gauntlett asserts that "making is connecting" (2011, 2). The act of making (something new) is connecting in the sense that materials and ideas combine within a social framework in ways that stimulate our engagement with the world. Taking a broader view that reflects the philosophical perspective of Gilles Deleuze, it can be argued that "all of life is a process of connection and interaction" (Colebrook 2002, xx). In a precarious and uncertain world, the challenge for thinkers and creators is to make "'new connections for thinking', opening up whole new planes of thought" (Deleuze, quoted in Colebrook 2002, xix). Deleuze and Guattari (1987: 296) explain that creations are "like mutant abstract lines that have detached themselves from the task of representing a world, precisely because they assemble a new type of reality that history can only recontain or relocate in punctual systems".

In this book, we argue that the *everyday dynamics*, as a shorthand for the ethical dynamism of creativity that rides on and harnesses human connectedness, can become a mechanism for assembling a new type of

reality that we desire (and require) to address the problematic complexities of our world. It is timely and relevant to consider the relationship between creativity and connectedness. As Mark Thomas, Professor of Evolutionary Genetics at University College London, puts it: "It's not how smart you are, it's how well connected you are" (cited in Pringle 2016, 10). To be well-connected implies a dynamically productive relationship between creativity and connectedness. Rather than a marker of attachment or fixity, connectivity is a conduit to openness and flexibility, yet informed by ethical perspectives and principles.

Adopting a sociocultural approach, Vlad Petre Glăveanu describes creativity as "grounded in openness" and as capturing "our flexibility towards the world, expressed in the ever-present possibility of changing course and developing new perspectives on any given problem or issue. The fact that we are not trapped within our perceptual here-and-now is both a marker of creativity and its great achievement" (Glăveanu 2018, 156). Glăveanu outlines three dominant paradigms in the study and research of creativity: the genius or "He-paradigm"; the creative person or "I-paradigm"; and the social or "We-paradigm" (2010: 80). The latter gestures towards the social psychology of creativity, underpinning the conceptualisation of creative expression as a vital form of cultural participation (Glăveanu 2011). As Glăveanu (2013) contends, thinking about creativity beyond Rhodes' (1961) classification of the 4Ps (person, process, product and press) invites consideration of perspectives from a range of evolving and newly emerged inter- and multidisciplinary areas, including cultural or sociocultural psychology. We begin by considering some of the vital conceptual turning points that have defined our thinking on creativity—and by extension, on innovation.

Changing Conceptions of Creativity

Creativity is closely associated with originality in capitalist societies, but not at all in traditional and religious cultures including the Ancient Greek, Roman, Hindu, Taoist and Buddhist cultures and existing traditional first cultures today. Creativity, as we understand it today, would therefore have no meaning for ancient or traditional cultures. For example, Ancient Greek culture acknowledged the ability of poets, only, to bring something new into the world, but the source of their 'inspiration' was attributed to a muse. All other art, or techne, was the result of imitating ideal forms that were bound by natural laws. Ancient Hindu, Confucian, Taoist

and Buddhist cultures also understood creativity as a form of mimicry. However, the Romans used the terms *creatio* (creating) and *facere* and *creare* (creator) to indicate that sculptors and poets drew on imagination and inspiration to produce their work. The Latin *creatio* was used throughout the Medieval Christian period (500–1500 AD), but artists were considered craftsmen because God, alone, had the power to create from nothing. The idea of individual human potential only arose during the humanist shift we associate with the Renaissance period (Albert and Runco 1999). Art became evidence of humankind's God-given, or innate, ability. In this environment, Leonardo da Vinci (1452–1519) was able to ask questions, observe and conduct experiments in areas as diverse as engineering, medicine, architecture, music, mathematics, astronomy, sculpture and painting. These provided the necessary conditions for science to emerge in western Europe; as the rise of science increasingly challenged religious faith during the sixteenth and seventeenth centuries, the West began to shift from a religious to a secular worldview. The shift to secular and scientific knowledges also prompted a shift from otherworldly explanations of creativity to innate explanations that came to be associated with genius (Sternberg 1999).

As a result of growing faith in individual ability, the English political philosopher Thomas Hobbes (1588–1679) first noted the role of imagination, and by the close of the seventeenth century, it was accepted as the key to 'artistic creativity' (Albert and Runco 1999: 22). During the eighteenth century, there was a growing belief that rational thinking, which underpinned empirical science, could uncover all of the laws of nature and free individuals and societies at last from the constraints of nature. This included freedom from our dependence on the natural world for existence and freedom from our natural instincts and emotions. This optimistic Age of Enlightenment (also known as the Age of Reason) clearly placed enormous faith in the human ability, which in turn encouraged a growing interest in individual rights, freedom of speech and opposition to authority. These shifts opened the door for genius to be understood as human potential (ibid.).

Within this intellectual environment, William Duff tried to explain the cognitive (mental) traits of genius. In his published piece, *An Essay on Original Genius and its Various Modes of Exertion in Philosophy and the Fine Arts, Particularly Poetry* (1767), Duff identified the key cognitive traits of imagination, judgement and taste. He valued imagination above all because it expressed the ability of the mind to reflect, organise ideas

and make infinite new combinations, whereas judgement referred to the evaluation of these ideas and taste referred to an aesthetic adjunct of that judgement (Duff, in Runco and Spritzker, 1999: 316). Twentieth-century cognitive psychologists and twenty-first-century neuroscientists tend to agree with him. Duff (1767) was also the first to note the influence of social factors. It is important to realise that over three centuries ago, it was widely acknowledged that this human potential was subject to the wider political environment and could not flourish in a repressive regime. However, Duff's ideas also reflect the influence of Romanticism, which emerged in response to rationalism and the horrors associated with industrialisation (in Runco and Spritzker, 1999: 316).

The Age of Reason had placed enormous faith in the human ability to solve problems using 'reason', at the expense of 'instincts and emotions'. The rational scientific model was based on formal rules of research to demonstrate the rational laws governing physical nature, diminishing the significance of the individual in the process. However, due to the ongoing social and political turmoil during the shift from an agrarian to an industrial economy, an important counter-movement emerged (Runco and Spritzker, 1999). The Romantics (roughly 1770–1850) valued freedom differently because they understood that the purpose of individual freedom was to enable innate predispositions to flourish (Albert and Runco, 1999). In other words, they placed originality at the heart of creative genius, elevated emotions and individual imagination, and thereby freed artists from the rules that governed ordinary behaviour. Romantic works of art and literature therefore celebrated the importance of individual self-expression, for mental and moral health, and placed this squarely in nature. As a result, two models of originality emerged, which created a growing intellectual wedge between the rational scientist and artistic genius that would not be reconciled for another century (ibid.).

By the close of the eighteenth century, four important conclusions had emerged that continue to underpin our present understanding of creativity (Albert and Runco 1999: 22). According to Albert and Runco (1999: 22), the four conclusions were:

1. Genius is not tied to the supernatural.
2. Genius is a potential in all individuals.
3. Talent and genius are distinct.
4. Potential and its exercise depend upon a political climate.

During the nineteenth century, creativity was considered a fixed attribute limited to 'gifted' individuals and was associated with the fine arts, especially the visual arts, whose works were appreciated primarily for their imaginative, intellectual and aesthetic appeal. Scientists were interested in discovering the origin of 'artistic genius'; they asked the same questions that were still being asked in the twentieth century: What is creativity? Who has it? What are their characteristics and can creativity be developed? (Albert and Runco 1999).

Two important schools of thought within psychology emerged: those who argued that artistic genius was the result of an ability to make new associations, and those who argued for a systems approach to idea generation (i.e. synonymous with Gestalt theory in psychology). In 1879, psychologist Francis Galton drew on Darwin's theory of natural selection to deliver a ground-breaking statistical analysis of individual difference. Galton's analysis severed any connection between creativity and mysticism while also contributing to the enduring idea that the unconscious can be brought to consciousness by making intelligent associations between our thoughts (see Runco and Spritzker, 1999). While Darwin argued that genetic inheritance was the key, gestalt psychologists such as Max Wertheimer (1880–1943) famously argued that mental operations needed to be studied holistically because the mind creates patterns (ibid.).

In more recent times, while acknowledging the profound impact of genius, social psychologist Robert W. Weisberg (1993; 2006) has argued that "all creativity, including creativity at the highest level, is the result of processes of ordinary thinking" (Weisberg 2014: 141). Although creative thinkers can draw upon experience and expertise, and have the ability to bring a rich repository of responses to creative situations, the cognitive mechanisms underpinning their achievements "can be very ordinary" (Weisberg 2014: 139). In other words, creativity can be found in a myriad of places, derived from most ordinary people. This 'ordinariness' therefore exists on the level of the everyday—in the way we both conceptualise creativity and apply innovation in daily practice—this book directs its attention to the notions of creativity and innovation firmly situated within the ordinary and everyday.

Ordinary Creativity: Everyday Dynamics and Innovative Practice

It is important to state from the outset that creativity and innovation must be studied from the perspective that it is always in-process, ongoing and necessarily disruptive and incomplete. Viewed through these lenses, creativity and innovation are not high-brow and only achievable by a privileged few, but everyday practices that ordinary or 'average' people are capable of. In this book, we seek to show how the everyday dynamics of creativity and innovation is what makes the ordinary extraordinary.

In the five chapters that follow, we unpack and demystify the broader and twin discourses of creativity and innovation. In the chapter that follows (Chapter Two), we examine key historical developments in the way creativity has been theorised that have in turn led to how we understand and value creativity in our contemporary era, particularly in Western culture and societies. Chapter Three adopts a similar approach to consider how innovation is intimately tied to the prosperity—and social well-being—of nations, even though it is commonly associated with changes, even disruptions, to the status quo. Innovation, in practice, can be deemed the application of "necessity with fresh eyes" (Austin et al. 2020), which implies that the innovation imperative is often preceded by an urgent need, technological shifts or even a crisis, such as climate change or a pandemic. The chapter offers examples of innovative COVID-19 responses during the critical years of the pandemic (2020–22) to illustrate how everyday dynamics can spark and inform innovative practice.

Chapter Four takes the book into an everyday 'practical' direction by drawing on a range of creative thinking tools and presents them as 'prompts' or strategies. These creativity prompts can enable, enhance and encourage both convergent thinking and divergent thinking that are the hallmarks of creativity and the creative process. The chapter takes us on a journey through a selection of creative thinking prompts, including: asking questions, analogy, assumption surfacing and provocation, attribute listing, brainstorming, the 6 thinking hats, forced connections, lateral thinking, mindmapping, PMI (plus, minus and interesting), reversal and SCAMPER. We explore and explain how these prompts can be used and how they might be beneficial in the generation or refinement of ideas or problem-solving. Chapter Five follows along a similar 'practical' trajectory by outlining the creative problem-solving process and exploring the challenges posed by difficult problems. In this chapter, we

explore the importance of building team environments and the characteristics of effective teams in enhancing everyday creativity and generating opportunities for innovation.

The final chapter provides a brief conclusion to our discussion by considering the everyday dynamics that are almost always present in the practice of creativity, especially as they relate to big problems such as COVID-19 and climate change. We consider how digital technologies, such as artificial intelligence (AI), have and will continue to challenge our thinking and ethical perspectives around human creativity and what counts as innovative and original creation. Above all, we ruminate on the future of creativity and innovation, and the applicability of creative processes to solve new and bigger problems.

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CHAPTER 2

Understanding the Creative Process

Abstract This chapter focuses on the meaning of creativity and ways that "being creative" and "creative products" have been approached and valued. We begin by exploring some understandings of what it means to be creative. This includes how creativity and creative products have been evaluated and measured, specifically the degree to which they demonstrate creativity and the cultural, economic and global needs that they cater to. We then turn to the evolution of approaches to creativity that have seen creativity go from a quality and characteristic of a gifted minority to, more recently, something that can be learned, developed and harnessed. We then examine creativity through Mel Rhodes' 4 Ps of creativity: person, product, process and press. The 4 Ps offer a way of focusing in on different aspects of creativity to reveal how creativity happens, to who, with which environmental influences and to what end. To conclude the chapter, we consider recent developments in the theory and practice of creativity, specifically in terms of dynamism, paradox and affect. As we argue in this chapter, creativity can be learned and developed; however, there are considerations and factors that can hasten the process and make creativity accessible to a broader range of people.

Keywords Creativity · Creative thinking · The 4 Ps · The creative process · Divergent thinking · Big C and little C creativity

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Introduction: How to Think About Creativity?

The 'lightbulb' is probably the most common icon associated with creativity, representing the idea that a light goes off in our head when we have a bright idea. Though lightbulbs are only a little over a century old, the idea that creativity is mysterious, magical or divine is ancient. What we do know now is that creativity is not the result of chance or luck, that it is not about divine intervention or magic, and that it is not limited by genius or madness. Creativity is not a fixed attribute that you either have or you do not; rather, creativity is a potential that can be learned and developed.

Creativity has only been studied formally since the late nineteenth century, which is when many of the science disciplines emerged. What prompted researchers to take an interest in creativity was part of a larger conceit that everything was ultimately knowable and if the creative process could be understood, it could be measured and developed. Before we embark on our contemporary understanding of creativity, it is important to recall that the way in which creativity is understood varies across cultures and has changed over time. What this suggests is that creativity is likely a socially constructed concept. As a result, there is no universal definition. At best, there is only a general agreement, as we shall show in this chapter.

Since this chapter and our book is a response to the current post-industrial interest in creativity and innovation, we proceed from an essentially Western understanding of creativity and from an assumption that creativity and innovation are highly valued. It must be noted, however, that while appearing to be 'common sense', assumptions of value are always nuanced, which means that the value accorded to creativity and innovation should be a matter of ongoing critical reflection. James C. Kaufman (2018), for example, suggests that it is timely for researchers to focus on *why* creativity matters and to expand our thinking about its benefits, especially in relation to corporate and academic success. Kaufman argues that although studies show that creativity drives economic and technological growth, creative workers command high salaries, and the desire for creative products is strong, we need to "mobilise and put forth suggestions for the new creativity agenda" (2018, 130). Conscientiousness is offered by Kaufman as one of many traits or abilities that may rival creativity in the promotion of success. With this in mind, "we need to focus on the myriad of additional benefits that creativity can offer"

(Kaufman 2018, 130). Other authors take a philosophical approach to the social value of creativity.

Challenging entrenched assumptions is an important part of the creative process. Emma L. Jeanes (2006) contends that discourses about creativity are essentially conservative and should be challenged. We need to be open to new ways of thinking and to "creative processes we do not recognise" or that do not reflect existing ways of assessing and measuring creative output (2006, 133). Jeanes argues that Gilles Deleuze offers us a way to reflect on "our desire for, and means to becoming, creative" (2006, 128). In particular, Jeanes engages with the Deleuzian view that dominant ways of thinking and understanding are generally institutionalised and therefore "inherently uncreative". Deleuze contends that philosophers should resist focusing on pre-existing things and ideas, and instead strive to generate *new* concepts. He supports a *becoming* that embraces previously unimagined modes of thinking and "what *might/could* be—the creation of what is not yet" (Jeanes 2006, 128). According to Deleuze, this approach is valuable precisely because it unsettles our current way of thinking about creativity, which generally relates to the *realisation* of ideas. Since realisation is "guided by" *resemblance*, there is little opportunity to think differently, especially in the context of capitalist culture where creativity is "over-romanticised" (2006, 130), and since change is central to capitalism, we are discouraged from questioning the *need* for change.

There are many ways to think about novelty (Kaufman and Baer 2012; Simonton 2018) and the value of creativity (Weisberg 2015; Harrington 2018), and, indeed, the closely aligned value of innovation (which will be unpacked in Chapter 3). At this juncture, innovation is to be understood as the process of converting creative ideas into viable commercial—and to an extent, non-commercial—products, practices or services. We adopt the stance in this chapter that creativity and innovation are widely regarded as *cultural*, *economic* and *global* imperatives. We unpack these three imperatives in the next section of the chapter; following which we identify the key contributions to creativity theory during its formative period in the twentieth century. In the latter half of this chapter, we expound on what Mel Rhodes (1961) refers to as the 4Ps of creativity: product, person, process and press, all of which combine to help us see creativity as an *everyday dynamic*.

Cultural Necessity

Creativity and innovation are widely regarded as a cultural necessity. This is true regardless of whether we think in collective terms (as a society, state or private enterprise), or as individuals. In the twenty-first century, creativity is increasingly valued by employers and nation states as a core competency for everyday life. Creativity is widely associated with the 'arts', which means that it is highly valued for two reasons. Firstly, the 'arts' are considered civilising influences that provide the moral compass for society, as well as a range of indispensable, fundamentally beautiful products that are aesthetically sublime. Secondly, the 'arts' play social and political roles in society. Products that are provocative or challenge the status quo encourage society to ask questions and think critically. Though the products are often quite contentious, they continue to be highly valued in all societies, regardless of whether the state supports this aspect of the 'arts'. Creativity is also valued at the personal/individual level in terms of self-expression and in its ability to solve everyday problems; moreover, it is increasingly valued, therapeutically, for good mental health.

Economic Necessity

Creativity is highly valued as an economic imperative in our society. It is now widely understood that creativity and innovation underpin national wealth. This is because we live and work within a capitalist economy that can only exist and thrive if we develop new ideas through to market. In the following chapter (Chapter 3), we will discuss different types of innovation. For example, the shift from the dial or pushbutton phone to the digital smart phone is an example of a *disruptive* innovation, whereas the shift from the ipod 1 to ipod 2 is an example of *incremental* innovation. Large corporations, cities and national bodies concerned with improving national wealth are therefore also vitally concerned with understanding how to provide the necessary conditions to develop creativity. However, the rate of change brought about by creativity and innovation since the late nineteenth century is unprecedented in history. For example, 120 generations ago, humanity invented the wheel, and 14 generations ago, Gutenberg's printing press introduced the mass production of books and manuscripts, but in just three generations there have been more inventions than in the whole of history. This also means that the rate of change

is escalating exponentially. Whereas Gutenberg's invention of the printing press took 400 years for printed books to achieve global saturation, it took only 50 years for the telephone, seven years for the mobile phone and just three years for social media. This has resulted in a shrinking half-life of knowledge and unprecedented social change.

Global Necessity

Creativity and innovation made possible the wondrous inventions of electricity, motor transport, plastic and nuclear waste, but these have also unleashed dangerous pollutants into the environment. It is inevitable that new ideas involve unintended consequences that are not always positive, but global warming, poverty, pollution and environmental degradation are clearly the big issues of the twenty-first century. However, as Einstein famously said: "We can't solve problems by using the same kind of thinking we used when we created them." For this reason, creativity is a global necessity because scientists and politicians are relying on innovations to provide sustainable solutions to these problems. However, warfare, which appears to be an example of a destructive form of creativity, has been a significant catalyst for myriad useful inventions including the now ubiquitous World Wide Web (www). The point is that creative innovations are always accompanied by unintended consequences that inevitably involve or invoke ethical issues.

Creativity is necessary in times of uncertainty. In periods when shifts in technology, politics and/or the environment threaten the status quo, creative tools are needed to make things "sharply different" and "radically new" (Nussbaum 2013, 27). Adopting collaborative processes that assist our survival in an increasingly volatile world means attending to group and cultural dimensions of creativity, rather than maintaining a focus on the individual. Imagination and participatory forms of creativity are needed to meet the challenges of what Alfonso Montuori (2011) refers to as post-normal times or the period in which familiar orthodoxies are declining and new ones are yet to emerge. Montuori argues that in this context, discourses and practices of creativity are changing from atomistic and individualistic to collaborative, contextual and ecological, a change that has implications for "the creativity of the future and the future of creativity" (2011, 221).

The COVID-19 pandemic which arose in Wuhan, China in late-2019, illustrates our key theme that connectedness is vital for stimulating

creativity. Unprecedented circumstances highlight both the complexities of connectedness and the role connectedness plays in addressing critical social problems. With few roadmaps to follow, historical perspectives offer insight into similarly challenging events such as the Spanish flu of 1918–1920 (Skosana 2020), estimated to have killed fifty million people worldwide (Williams 2018). Connecting with the past is a form of "knowledge-mining" (Nussbaum 2013, 44) through which unrelated fields or bodies of knowledge intersect to create the possibility of something new. Social scientist and physician, Nicholas Chistakis (Morrow 2020), explains how COVID-19 exploits human sociability, and our desire for close physical proximity. Nonpharmaceutical interventions such as social distancing, which are aimed at slowing the spread of COVID-19, directly challenge the human tendency to form groups, assemble and socially interact. Chistakis argues that although humans have evolved to be social animals, the immediate challenge is to temporarily modify this inclination, while not losing sight of other qualities and practices, such as cooperation and the capacity for social teaching and learning that have benefitted human survival. One possible advantage of this dire global event is that considerable international knowledge-sharing is occurring (Skosana 2020), and opportunities to share ideas and information abound. A positive outcome to date has been the adaptability of companies to repurpose their staff and production sites into making much needed supplies. This includes Italian fashion label Armani tasking its factories with making medical overalls, Californian-based sports clothing company De Soto using their highly technical fabrics to make protective wear such as masks and head tubes and Elon Musk's SpaceX and Tesla factories designing and building respirators. In France, LVMH chairman and chief executive Bernard Arnault, whose company produces perfumes and cosmetics for Christian Dior, Guerlain and Givenchy, manufactured hand sanitizer to help address the shortfall in hospitals and health facilities.

Confronting the myriad challenges of COVID-19 reveals the strength of our capacity for creative responses. Strength lies in our ability to connect and, through strategic connection, to *act* on the basis of shared humanity. In the context of the COVID-19 pandemic, these connections apply to daily fundamentals such as eating and family life. In the wake of restaurant closures in the United States, Spanish-American chef, José Andrés, converted some of his eateries into community kitchens. Customers could take food home or eat from take-away windows (Kelly 2020). In Australia in the early months of 2020, when panic grocery

buying was at its height, supermarket chains Coles and Woolworths placed restrictions on the purchasing of certain staple items, a measure echoing government-sanctioned food rationing during the Second World War (Samuelsson 2020). With swelling numbers of people confined to their homes, food and creative play activities for children became popular topics on social media (Samuelsson 2020; Harper 2020). Martha Stewart and Ina Garten were among the personalities offering culinary tips on Instagram and social media (Samuelsson 2020).

Therefore, the COVID-19 pandemic has shown that creative and innovative solutions can arise quickly and efficiently in times of crises, demonstrating the adaptability of humans in particular circumstances. We now turn to creativity theory and some of the milestones in its development in the twentieth century.

Key Contributions to Theories of Creativity in the Twentieth Century

It is no coincidence that 'creativity' was the subject of cognitive science, or a science of the mind, at the turn of the century, and by neuroscience, or a science of the brain, at the close of the century. Creativity became a subject for scientific enquiry because of a raft of new scientific disciplines such as biology, anthropology, geology, economics and, particularly, psychology. As it is not possible to list them all here, this section highlights some of the more influential philosophical positions and approaches to creativity that emerged during the twentieth century.

Perhaps the most influential point of departure for research on creativity occurred in 1950, with Joy Paul Guildford's (1897–1987) landmark Presidential address to the American Psychological Association, titled 'Creativity'. Guildford (1950) was working with airline pilots during WWII, trying to find out why some survived and coped better than others. He became interest in creativity as a result of his research into personality and intelligence testing during WWII. During his time as the Director of Psychological Research at Santa Ana Army Air Base, he improved the survival rate of US pilots, bombardiers and navigators by developing a system that identified and measured mental abilities. In the process, he realised that conventional intelligence testing had no way to measure creativity. Lamenting the scant research into creativity, he urged psychologists to focus on the area in order to develop the creative talent necessary for industry, science, arts and education (Guildford 1950).

Creativity did become an increasingly important area for investigation in the USA during the 1950s, largely due to the Cold War. When, in 1957, the USSR successfully launched Sputnik, which was the first satellite to orbit earth, Americans were shocked. The event marked the beginning of the Space Race, but it also unleashed enormous political, scientific and educational interest in developing the nations' creative thinking skills. Guildford's work to identify and measure human intelligence and creativity was therefore timely, and he is best known for his landmark psychometric research, specifically his 3D model of intelligence: the Structure of the Intellect (SI) (Guildford 1950). He studied creativity as a form of human cognition, using a highly complicated model for measuring 180 mental abilities, which he organised in terms of three dimensions: operations, content and product. Guildford was not the first to view intelligence as complex and multi-faceted; his SI theory has been superseded by Robert Sternberg and Howard Gardner and the findings of neuroscience. Yet, many tests still used today were either created or modified by Guildford. He developed a highly complex mode of intelligence that provided an important stimulus for research and highlighted the significance of divergent thinking, which was one of his five 'operations' (ibid.).

Guildford (1950) invented the term 'divergent thinking' to explain the generation of multiple answers to problems that have no obvious or single answer, and contrasted this with 'convergent thinking', which works to achieve single, correct solutions. He argued that although both operations were essential to creativity, the development of logic and reason, which underpin convergent thinking, was much more highly valued in IQ tests and our education system. He therefore invented a test to measure divergent thinking by assessing responses to problems that have no obvious or single answer, using the following categories: 1) Fluency: how many things you can think of; 2) Flexibility: how many different types or categories the 'things' fall into; 3) Originality: how unusual or comparatively rare the response; and 4) Elaboration: the degree of detail.

These four categories form the basis of the Torrance Tests for Creative Thinking (TTCT) that has been the leading international tests for creativity since the 1970s. Created by one of Guildford's students, Paul Torrance, the Figural TTCT uses picture-based exercises to assess five mental characteristics (fluency, elaboration, originality, resistance to premature closure and abstractness of titles), while the Verbal TTCT uses word-based exercises to assess three mental characteristics (fluency,

flexibility and originality). As there is more to creativity than divergent thinking, these tests cannot accurately measure all forms of creativity, but show that as an attribute, creativity can be developed.

Since Guildford's address in 1950, there has been a significant amount of research focused on ways to measure, develop, predict and harness creativity. The discipline of psychology leads this endeavour. However, the disciplines of education, humanities, business and science have each made valuable contributions during the twentieth century (Hennessey and Amabile, 2010). It is not possible to address the contribution of each field here, but the following theorists and their ideas introduce some of the key ideas that we refer to in this chapter (and in other chapters in the book).

Koestler's *The Act of Creation* (1964) attempted a general theory of human creativity and is best known for introducing the concept 'bisociation' and the roles of Artist, Jester and Sage. Bisociation refers to the way in which creativity arises from the intersection or blending of two different or unrelated frames of reference. Mental processes based on comparison, such as analogy, metaphor, anthropomorphism, allegory and so on, are special forms of 'bisociation'. Bisociation occurs when we hold two unrelated planes of thought simultaneously, which is what occurs when we understand a pun (ibid.). Koestler (1964) also introduced the roles of Artist, Sage and Jester to represent the diverse faces of creativity: the Artist represents the search for beauty and elegance in form and solution; the Sage is the problem-solver; and the Jester is the joker who thinks and speaks the unsayable.

Many cognitive scientists, or scientists of the mind, have made a significant impact in the twentieth century. Ronald Finke, Thomas Ward and Steven Smith (1992) introduced the Geneplore Model to explain the creative process. It refers to two phases: the generative phase, which is about creating lots of ideas, and the explorative phase, where these ideas are expanded and explored further. It includes 'preinventive' structures to explain fleeting thoughts and feelings, those parts that need to be re-iterated and revised until they are more fully fleshed out to produce creative ideas. This is also a useful way to remind us that we can move back and forth between these phases to avoid becoming stuck or bogged down in any one stage.

Robert Weisberg's research is focused on understanding problem-solving and creative thinking. Weisberg draws on the extraordinary achievements of scientists and artists as case studies to illustrate how

Table 2.1 First and second generation creativity

Big C 1st generation	*Little c 2nd generation*
• Luck • Individual • Spontaneous • Outside box • Arts based • Natural innate	• Social economic and political imperative • Collaborative • Dispositional and Environmental • Rules, bounds • Crosses disciplines • Learnable

(*Source*: Adapted from McWilliam, 2008: 10)

ordinary cognitive processes produce extraordinary results (1993; 2006). Robert Sternberg's Triarchic theory of intelligence refers to analytical, creative and practical intelligences. He argues that creative intelligence refers to the ability to draw on existing knowledge and experience and to address new problems by transferring information from one problem to another (ibid.).[1] More recently, there has been a major synthesis between cognitive psychology and neuroscience, or the science of the brain, that has given rise to a new biological science of mind. Functional magnetic resonance imaging (fMRI) and other types of brain imaging play a key role in this by showing that creativity and imagination begins with perception, which is a product of the brain rather than our senses.

This brief overview demonstrates the shifts that have altered the way that creativity is understood. Table 2.1 summarises these changes by differentiating between first- and second-generation creativity, as proposed by Erica McWilliam (2008), and which outlines more recent shifts in thinking about creativity.

The above table clarifies the conceptual shift from understanding creativity as a mysterious process that arises spontaneously in individuals who have been blessed by some otherworldly intervention, to understanding it as a collective practice, and "a necessity for all" (Csikszentmihalyi 2006, xviii). It also traces, and possibly refutes, the idea that creativity is a fixed attribute that remains within the romantic image of the depressed and lonely artist in the garret. For example, you may already

[1] American psychologist Howard Gardner (1993) and Neuroscientist Nancy Andreasen (2014) have both made significant contributions to the study of intelligence by introducing multiple intelligences and forms of intelligence.

have come to believe that *you* are not creative or have been told that you are the '*creative one*' in the family. However, second-generation thinking about creativity is underpinned by the idea that all humans have an innate human capacity for creativity, that it is a collective practice evident in all disciplines, and is bound by rules and affected by our environment. Creativity is a vital personal and professional asset as well as a social, economic and political imperative for developing creative thinking skills and creative solutions to global problems.

Where creativity was formerly associated with the fine arts (painting, architecture, sculpture, music and poetry), a range of 'creative industries' emerged during the twentieth century: advertising, animation, television, radio, film, photography, printmaking, installations, design, fashion, digital media, software, video games, toys, publishing and research and development. However, Richard Florida's concept, 'the creative class', introduced in his seminal *The Rise of the Creative Class* (2002), reflects this shift from industrial capitalism to 'creative capitalism', the latter of which is powered by scientists, engineers, entrepreneurs and artists who have the ability to solve problems and create new opportunities, ideas and products. He demonstrates that the creative class has become the most rapidly growing sector in the workforce because more creative *employment* occurs outside the *creative industries*. Creativity is not only embedded across many sectors, but digital technologies and social networking have resulted in their creative capital moving from the margins of economic life to the centre as a social, political and cultural imperative. Florida (2002, 2005) and Charles Landry (2000) have also invigorated a reimagining of cities as hubs for developing creative economies.

There is a great deal of research that highlights the significance of creativity as a personal and professional asset that is highly regarded by employers and vital to the fortunes of cities, states and industries. For example, the *Global Creativity Index*, which was created in 2011, demonstrates the significance of this global shift from economies based on industrial capitalism, characterised by natural resources and large-scale industries, to 'creative capitalism' powered by the inexhaustible resources of human capital: 'knowledge, innovation and talent' (Florida, Melander and King 2015, 8). This index also 'focuses on the role of cities as the key economic and social organising unit of global capitalism' (Florida, Melander and King 2015, 2). It measures creativity and the three conditions that Richard Florida (2002) identified as necessary to attract creative

people to generate innovation and stimulate economic growth in contemporary creative cities: Technology, Talent and Tolerance. For Florida, the combination of these elements encourages and sustains creative economies. There is a correlation between diversity, talent and high-tech industry, and technological development is closely aligned with tolerance, acceptance of newcomers and openness to racial, ethnic, gender and sexual diversity. Specifically, "the growth and development of great cities comes from their ability to harness diversity, welcome newcomers, and turn their energy and ideas into innovations and wealth" (2000). Diversity is therefore fundamental to the establishment of successful high-tech centres, and also strongly reflected in the values and choices of employees who seek to live and work in open and tolerant communities.

Recent national policies also demonstrate the centrality of creativity to productivity and sustainability in the twenty-first century (Landry, 2000; EUA, 2007; Florida, 2005; McWilliam, 2008; Pink, 2005; Csikszentmihalyi, 2006). Paul Keating's *Creative Nation* (Department of Communication and Arts 1994) (subsequently replaced by Creative Australia: National Cultural Policy in 2013), Tony Blair's 'Cool Britannia' and the Creative Industries Task Force (1997) were early responses that demonstrated a growing awareness of waning natural resources: social, economic and political changes linked to post-industrialisation and globalisation. The *Creativity in Higher Education: Report to the EUA Creativity Project 2006–2007* (EUA 2007), the UK's *The Design Economy Report* 2015; Australia's *Building a Creative Innovation Economy* (Cultural Ministers Council 2008) and *Australian Innovation System Report* (2015); the OECD's *The Innovation Imperative: Contributing to Productivity, Growth and Well-being* (2015); Singapore's *Creative Industries Development Strategy* (ERC 2002); and China's foray into the global creative cum cultural space (for example based on Jingcheng Zhang's *The Development of the Creative Industries in China*, 2007) are a few of the key policies that 'reflect the increasingly important contribution that creativity makes to national economies' (Delmege and O'Mahony 2013: 2).

Florida's (2002) concept of the creative class reflects the shift in thinking away from big 'C' creativity, to little 'c' creativity. He differentiates three groups: the producer, the technician and the secretary. Creative producers are the Nobel laureates, the scientists and engineers, architects and designers, philosophers and psychologists, visual and performing artists and writers who produce immortal works and new paradigms. The thought leaders are the professors, policy-makers, writers, editors,

researchers, analysts, opinion-makers and cultural figures who encourage and foster opportunities and a favourable climate. Creative technicians are the people who solve specific problems in finance, engineering, health, business and high-tech industries and are primarily concerned with applying expertise to solve problems in new ways (Florida, 2002, 2005). Finally, the 'creative secretary' refers to the people who interpret information to develop new ways of operating in the everyday.

Since the 1970s, in accordance with the demands of a growing knowledge economy, urban planners have paid increasing attention to environments that are conducive to the generation of creative and innovative ideas. Silicon Valley is a primary example, as well as "Silicon Alley in New York, Silicon Roundabout in London, Orestad in Copenhagen, Brainport in Eindhoven and one-north in Singapore" (Yigitcanlar 2014). Australian examples include "the Australian Technology Park in Sydney, Parkville Knowledge Precinct in Melbourne and Kelvin Grove Urban Village in Brisbane" (Yigitcanlar 2014). Urban knowledge precincts have the dual roles of nurturing and facilitating small high-tech firms, and promoting regional economic growth. In addition to specific knowledge hubs, Yigitcanlar suggests the importance of forming "networks of innovation" that traverse a city. Cafes, restaurants and cultural and sporting venues are examples of other sites where "like-minded workers" connect to share tacit knowledge. Marcus Foth (2015) refers these "open and accessible" spaces for thinking, innovating, doing and making as "Skunkworks" and identifies the Old Truman Brewery in London as a notable example. On a heritage site, it combines spaces for exhibition, incubation and hospitality, and being close to Campus London; game developers frequently meet with fashion designers to stage impromptu fashion shows, serviced by a variety of food trucks and baristas. While the most successful knowledge precincts "generate a spill-over effect" (Yigitcanlar 2014), Foth reminds readers of the creative impetus of "in between spaces" such as co-worker spaces, hacker spaces, maker spaces and living labs. He writes that "cities are smart when they enable the smart citizens" and urges against "entrepreneurial gatekeepers" in favour of inter-disciplinary perspectives and the productive disorderliness of creative imagination (Foth 2015).

The 4Ps of Creativity

Perhaps the most general, and widely agreed, definition of creativity is an idea that generates a product that is original and useful (Runco and Jaeger 2012). We can explain why the focus falls on production in two ways. Firstly, the 'product' is the prime concrete aspect of the

phenomenon we call creativity. Secondly, we live in a capitalist society that is highly dependent upon the ongoing production and consumption of original and useful products. We could include an aspect of the person within this definition: 'creativity is an ability to generate new and useful products' (ibid.). The focus remains on the product, but this definition recognises the person (or people) and the process as components of creativity. Morris Stein's (1953) early definition also acknowledges the context within which a product is produced: "that process which results in a novel work that is accepted as tenable or useful and satisfying by a group at some point in time" (Stein 1953).

However, in our working definition, creativity involves a person, product, process and environment (within which these three components function): creativity entails a *process* that involves an *agent* and results in a *product* that is accepted as creative in terms of the social, political and economic *environments* within which the agent, process and product function. Our definition reflects what Mel Rhodes (1961) found when he set out to provide an overview of the existing research into creativity. What Rhodes found was that researchers tend to focus on one of four areas. He referred to these as the 4Ps: ***product, process, person*** and ***press*** (which we can think of as 'environmental pressures'), and it remains a very useful approach for clarifying the complex phenomenon that we call creativity. The 4Ps is like a prism, splitting and honing our focus as it highlights their interdependence. For example, when you think about creativity, what comes to mind? Is it a particular person, or is it what they created, or do you think about the process involved in its production? What we focus on reflects our interest, which is always the case for researchers too. However, few people give thought to the wider social, economic, cultural or political climate or contexts within which this occurs. For this reason, the 4Ps provides an especially useful way of understanding the multilayered role of context. Whether we think about the present or the past, creativity is either enabled or constrained in terms of social, economic, cultural and political pressures at every level from the personal to the global. The point is to understand the central significance of context because what counts as creative is always specific to culture, time and place (Kharkhurin 2014; Kwan, Leung and Liou 2018). Just as few creative products appear to stand the test of time or to be widely accepted, not all creative individuals are recognised in their own lifetime. Equally, it is not hard to realise that creative processes are subject to

change: we only need to think about the growth of digital creativity to recognise that technology is a major catalyst for change.

Creative Products

What is the first creative product that comes immediately to your mind? Is it an 'object' or an idea? Would you classify it as belonging to the arts or sciences? Depending on your interests, it may be a famous artwork, piece of music or literature; a famous scientific theory such as Einstein's $E = mc^2$, a philosophical, social or political idea; and a mathematical, medical, engineering or technological innovation. Whatever you choose, it is likely famous and widely acknowledged by society because some products are much more highly valued than others, for example, $E = mc^2$, the Mona Lisa, the Sydney Opera House, electricity, Occam's Razor, the telephone or the World Wide Web. Since a creative product can be an idea, an artefact, a property or a potential, there is a wide range of research in this area, depending on who wants to know what and why. Some theorists distinguish the products of everyday creativity, from those deemed to be elegant or that demonstrate a generalisable or transferable property. Elegant solutions are often so immediately simple and obvious in retrospect that others wonder why they had not been thought of before. Those which are generalisable however introduce an element that is entirely new, as either a way of thinking or approaching an area or problem. This brings to light a problem that was previously unnoticed, suggesting the need for a new way to proceed, or laying a foundation for a later innovation. However, given that we live and work within a global capitalist environment, a great deal of research interest comes from corporations, governments and universities who are keen to encourage creative innovation. Recalling our most generally agreed definition of creativity—*Creativity produces a product that is original and useful*—for a product to be considered creative, there must be an agreement that it is both original and useful. Bearing in mind that what counts as a creative product is culturally dependent, within the existing dominant capitalist discourse on creativity, there is a great interest in products that offer a solution to a problem, or at least appear to do so.

Research shows that many of the products considered creative are produced by bringing people from different disciplines together or by someone who has knowledge of more than one. For example, Alex Rigopulos, a musician, and Eran Egozy, an engineer, founded Harmonix Music

Systems and created music video games Guitar Hero and Rock Band that made them billions of dollars (Karagianis 2013). In other words, Rigopulos and Egozy are significant because their products were deemed to be new, appropriate and useful. Bringing teams together is standard practice in major corporations. For example, Bell Labs invented the laser, the transistor, the communications satellite, photovoltaic cells, the UNIX computer operating system, high-definition digital television and digital mobile phones, precisely because they encouraged 'spontaneous teaming' between diverse disciplines. Perhaps you have personal experience of combining diverse skills and knowledge to solve a problem creatively. You could be an engineer and on the weekend a sailor, having developed expertise in two different areas. When a problem arises, you are therefore able to draw on your disparate skills and knowledge, to generate an original and useful or appropriate solution. This may not achieve the value or awards associated with Nobel laureates or the fame and fortune that attends leaders in the arts and business worlds, but it is a good example of the type of everyday creativity that we are all capable of. This is certainly the case for most new physical products that are accepted as 'filling a need', even if that need is manufactured by clever marketing. Indeed, 70% of product innovations come from consumers, inventors or people who just want to solve a problem, and people who recognise an unmet need, or see a gap in the market. Products that act as a solution to a problem also occur due to cross-, multi- or inter-disciplinary knowledges, and breakthrough solutions also come from people outside the problem area.

Creative People

Much of the research focus on creativity in the twentieth century was undertaken by cognitive psychologists who focused on understanding creativity from the perspective of the human mind. This remains the case. A range of interests and approaches are employed across the field of psychology, but for all their differences, and there are many, there is a general agreement about the range of the *cognitive, personality and motivation* characteristics associated with creative people.

Cognitive Characteristics

The word 'cognition' refers to all of the mental processes associated with knowing, including how we perceive, store, retrieve, evaluate and

synthesise information and pieces of sensory data. Cognitive psychologists classify human cognition as conscious, unconscious, conceptual, intuitive, abstract and concrete. Predictably, the disciplinary areas most interested in the cognitive characteristics of creative people are psychology, education, computer science, philosophy, biology, neuroscience and cognitive science. A summary of Sternberg's (1988) comprehensive account of this complex area shows that creative people characteristically demonstrate the following traits, abilities and processing styles:

- TRAITS: highly intelligent, original, verbally fluent, articulate and imaginative.
- ABILITIES: thinks metaphorically, flexible, makes decisions, copes with novelty, thinks independently and logically, visualises, finds order in chaos and escapes perceptual sets, which refers to the ability to resist being influenced by previous experience to the point that our expectations affect the way we interpret new information.
- PROCESSING STYLES: uses wide categories, uses non-verbal communication, questions norms and assumptions, builds new structures, is alert to novelty and to gaps in knowledge and uses existing knowledge as a base for new ideas (see Sternberg 2006: 434).

Cognitive psychologists agree that creativity involves the ability to generate ideas, and to act on and evaluate those ideas, but they also agree that the ability to generate ideas is most important. Since an idea is the visible *product* of the creative process, it is easier to measure this component than the person, process or environment, which might explain why this is the single largest area within the study of creativity. Typically, cognitive psychologists have measured the ability to generate ideas using a range of psychometric tests. Consider the following three examples:

1. The Torrance Test of Creative Thinking (TTCT), developed by Paul Torrance (1974), measures divergent thinking using:
    - Fluency: the total number of interpretable, meaningful and relevant ideas generated in response to the stimulus.
    - Flexibility: the number of different categories of relevant responses.
    - Originality: the statistical rarity of the responses among the test subjects.

- Elaboration: the amount of detail in the responses.

2. Frank Barron's (1988) Symbolic Equivalence Test measures the ability to think in symbols or metaphors.

   - Plot Titles: participants are given a story plot and asked to write original titles.
   - Quick Responses: a word-association test scored for uncommonness.
   - Figure Concepts: participants find qualities or features common in two or more drawings and are scored for uncommonness.
   - Unusual Uses: finding unusual uses for everyday objects such as bricks.
   - Remote Associations: participants find a word between two given words (e.g. Hand _____ Call)
   - Remote Consequences: participants generate a list of consequences of unexpected events (e.g. loss of gravity)

3. Carson, Higgins and Peterson's (2005) Creativity Achievement Questionnaire (is a self-report test that measures creative achievement across ten domains.

Personality

Research into the personal characteristics of creative people shows a number of common personality traits. To understand the type of personality, imagine someone without curiosity, who is not observant or interested in new ideas, places and experiences, or someone who does not listen to other people's ideas or ask questions, who avoids taking risks out of fear of failure. Such a person is closed to experience and development and, sadly, to a life of fun. Creativity has no opportunity to grow in such an environment. Imagine someone who is the polar opposite of this. That person is curious, is observant and is interested in new ideas, places and experiences; moreover, that person will listen to other people's ideas or asks questions and is willing to take intellectual risks. The point here is to understand that a creative personality is fundamentally open in their attitudes and behaviour.

It is also important to bear in mind that creative people are acknowledged as such because their products are widely regarded as creative. Any analysis of personal characteristics is therefore based on evidence in one particular field of interest and is not necessarily generalisable. In other

words, you cannot make sweeping claims that creative people, or people who produce recognised 'creative' products, always demonstrate any of the following recognised traits in other areas of their lives: curiosity, a tendency to wonder and ask questions, and an openness to new ideas, attitudes and experiences, all fueling an appetite for learning and a desire to observe, question and listen closely (Sawyer, 2007; Schell, 2008). Creative people are also reflective, self-disciplined and task-oriented, show a willingness to meet challenges, and to overcome obstacles by persevering in the face of failure and its attendant pressures. Creative people also tolerate ambiguity and uncertainty and take intellectual risks, they are less constrained by established ideas or methods and more inclined to ask the 'silly' questions. They also demonstrate an intrinsic motivation that provides the drive and passion to focus (Cropley and Cropley, 2009; Pink, 2005).

Motivation

There has been a great deal of research into the role that motivation plays in creativity (Gardner 1993; Amabile 1993). What we know is that creative people tend to be intrinsically motivated by personal enjoyment and the satisfaction they receive. Depth of interest and passion highly correlated with motivation is the key to the passion which is necessary to be able to work hard and persevere in the face of challenges. Highly motivated people also demonstrate intense concentration, at least in their area of interest. Csikszentmihalyi (1975; 1998) refers to the state of being in intense concentration, 'flow', which is why we lose track of time and forget to eat when we are deeply involved in a task. This letting go of 'what we already know' is significant because it weakens the natural tendency to make assumptions and leap to conclusions. This 'letting go' is precisely what is needed for the brain to make unexpected connections between unrelated ideas and different knowledge systems. This ability to 'let go' lies at the heart of creativity. Extrinsic motivation in the form of money, praise or performance plays a role in rewarding performance, but research suggests that this is not the key driver and may actually impede creativity if it is used to reward activity that is otherwise intrinsically motivated.

Creative Process

The creative process has always been the most mysterious aspect of creativity. In attempting to unpack the creative process, Jacques Hadamard's *The Psychology of Invention in the Mathematical Field* (1945) proposed a four stage creative process involving *preparation, incubation, inspiration* and *implementation*. Differently put, the necessary conditions for creativity, or the process to produce creativity, are a prepared mind, time to incubate and space to collaborate.

The first stage in the creative process involves *preparation*. This stage draws on everything we already know, including all our knowledge, experience, attitudes, beliefs and values. The more specialist knowledge and skills that we have at our disposal, and the more knowledge and skills that cross disciplines, the more material we have to work with. The preparation stage usually also involves some form of research, to gather, learn, practice and refine to develop mastery in whatever knowledge or skill is required. Highly creative people tend to have a high level of specialised knowledge. But at some point, we need to let it go because making connections between disparate skills and knowledge, which lies at the heart of creativity, requires time. This is what is referred to as the incubation stage.

The key ingredient for the *incubation* stage of the creative process is time, as well as the opportunity to share ideas. One reason for the importance of time in this stage is that the brain is usually very busy. Our senses take in millions of pieces of information that we have no possible way of accessing at a conscious level, which means that we always know far more than we actually realise. It also explains why our body insists on taking 'time out' to encode and store information, by losing concentration or 'daydreaming'. The term 'information overload' is an apt description for how we feel when this occurs. Albert Einstein explained this as giving his unconscious mind work to do, while the famous philosopher and mathematician Bertrand Russell talked about working as hard as he could and then letting it all go.

The medical technology of fMRI has demonstrated that imagination begins with perception, and that they use the same neural pathways, but in reverse. In other words, what we sense is due to perception, rather than the organs associated with each of the senses. This is because the brain is a highly efficient organ that filters to make predictions based on past experiences. Literally, we see, hear, feel, taste and smell what we expect.

Infants have no store of knowledge which is why they pay equal attention to everything, but if the brain did not take short cuts, imagine how long it would take to process every little thing we do. The point is that 'perception' is the most efficient way for the brain to manage or make sense of incoming information. The 'moving picture' works by this principal, filling the gap between one scene and another; we perceive a connection between say someone throwing a ball in one scene and someone catching it in the next, when the scenes may have actually been filmed at different times and places.

However, the flip side to this is that the more we already know, the less likely we are to generate an original response. Anyone who has ever been to another country discovers this when their brain tells them that they are seeing something that cannot possibly be the case. What we already know effectively short circuits our ability to generate new ideas. If we are used to seeing kangaroos rather than antelope, our brain activates the neurons that have been associated with this kind of category before: experience—dependent categorisation. As experience, or knowledge, strengthens neural pathways, the brain draws on fewer neurons to do the job. However, since creativity is associated with communication between areas of the brain that do not usually have strong connections, what is required is the development of new neural pathways, which is best achieved by mixing with new people, in new environments and being open to new experiences. Provoking our imagination by introducing new and/or unexpected experiences allows the frontal lobes to reprogram the neural pathways associated with imagination and perception so that we see things afresh, or through new 'eyes'. This is precisely what is needed to encourage intuitive leaps that draw on areas of the mind that are not controlled by rational thought (Fig. 2.1).

The figure shows the main parts of the human brain. Many areas in the brain appear to play complementary roles in the creative process, in just the same way that the sections within an orchestra work together to produce music. For example, the grey matter, the outer layer of the brain, which is known as the *cerebral cortex*, plays a key role in attention, perception, memory, awareness, thought, language and consciousness. The *frontal lobes* generate ideas that the *temporal lobes* edit and evaluate, triggering the creative insight or the 'aha' moment. Neuroscientists have also confirmed that emotions play an important role in the creative process. This is because the ability to be able to connect unrelated ideas is associated with dopamine, which is the neurotransmitter associated with

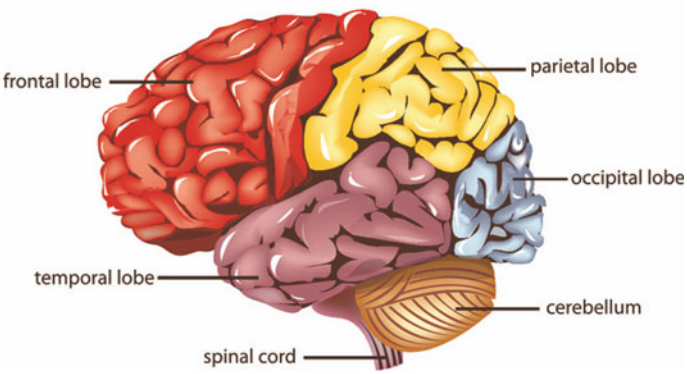

Fig. 2.1 Parts of the human brain[2]

allowing information to flow. When we are in a happy and relaxed state—but not too happy and relaxed—we produce enough dopamine to be able to manage a wide amount of information. This widening of our focus, especially to make connections between areas of the brain that do not usually have strong connections, lies at the heart of creativity. Neuroscience has also confirmed that abnormalities in the frontal lobe such as depression or anxiety can decrease creativity. Sadness or anxiety are quite useful for narrowing our focus during any evaluation of ideas stage, but they are less useful for generating good ideas, just as motivation is the key to following through and persevering.

Steve Johnson (2010) argues that most good ideas take a long time to evolve and are often dormant for long periods as partial hunches, before they are accessible. He provides the example of Tim Berners-Lee, who invented the World Wide Web. Berners-Lee did not have a full vision when he started and scrapped several ideas along the way, but after ten years, the full vision emerged. Johnson (2010) also argues that good ideas need space because breakthrough ideas come from the collision of smaller hunches. This reinforces the need to be open, as well as the significance of systems that allow people to mingle and share ideas. The coffee houses during the Age of Enlightenment and the Parisian salons of modernism were engines of creativity because they created space for

[2] Colour-coded lobes of the brain. Royalty-free brain diagram is taken from www.shutterstock.com.

ideas to mingle and create new forms. Johnson (2010) makes the point that improved connectivity has been the primary engine of creativity for the past 600 years from the development of the printing press to rail and telegraph, radio, satellite and the internet. The rise of social media has increased our chances of connecting with others or finding the information we need to improve our ideas. Johnson's key point is that breakthrough ideas do appear in moments of great insight or a sudden stroke of inspiration—such as the aforementioned 'light bulb moment'—but these moments are extraordinarily rare.

Inspiration: The 'Aha' Moment

Having enjoyed the time and space to meet people and share ideas, having given the unconscious time to work, time to get the conscious mind out of the way, good ideas have an opportunity to bubble through to consciousness. As a result, we can experience a moment of insight or sudden stroke of inspiration. Using fMRI (Functional Magnetic Resonance Imaging) and Electroencephalography (EEG), Mark Jung-Beeman et al. (2004) found that the 'aha' moment is characterised by the brain making new neural pathways and connections in the anterior temporal lobe of the right hemisphere, which integrates distantly related information. The 'aha' moment is preceded by alpha wave activity, which is associated with a relaxed state, before a burst of gamma wave activity that is experienced as insight.

Such 'aha' moments tend to occur when we are relaxed and are therefore often associated with the 3 Bs: the bed, the bath and the bus. 'Aha' moments could just as easily occur when you are out for a walk, or as the Perth-based novelist and illustrator, Shaun Tan, says, when he is doing the dishes.[3] 'Aha' moments could also occur when you are drifting off to sleep or when you wake in the middle of the night. Many notable creative people always keep a notebook or tablet with them to record ideas, however partial, as they occur, because such ideas will invariably be difficult to remember in the morning.

Verification

Verification is the final stage of the creative process, which could take a moment or a lifetime. Ideas are honed, expanded and formalised during

[3] See ShaunTan's blog: https://www.shauntan.net/

the verification phase. In this period of conscious attention, results are confirmed, and their consequences are deduced (Sadler-Smith 2015, 344). Although giving the appearance of sequential orderliness, the four stages can be considered "process states that may occur in cyclical, or varied patterns" (Lubart 2018, 7). In addition, as Cropley (2016, 240–241) points out, these phases and subsequent variations on them may occur at vastly different times, and without the conscious awareness of the creator. They can involve loops and digressions; for example, illumination could highlight the need for further preparation or verification might generate fresh ideas.

Creative Press

The creative press refers to every level of environment that helps or hinders creativity. This includes the aspects addressed in the previous three sections. We know that creative people, creative processes and creative products are all impacted by the prevailing social, political cultural and economic milieu at home, work and in our communities (Sawyer 2007; Gladwell 2009; Cropley and Cropley 2009; Amabile, Fisher and Pillemer 2014). These pressures affect who and what is considered creative at any point in time or place. This includes the internal values, beliefs and attitudes that constrain or enable the creative process as well the wider impact of socio-economic, intellectual and emotional environments at home, school, work and the society within which we live. For example, in what ways does a family or workplace help to develop a creative disposition by encouraging openness, curiosity and intellectual risk-taking? What values, beliefs and attitudes limit or enable our creativity at school and at work? Understanding this allows us to improve the conditions that cultivate creativity.

Research shows that environments that provide a supportive, enabling culture to maximise creativity can be described as high challenge, low threat. Such environments could include ways to:

- Encourage awareness of creative processes in ourselves and others;
- Encourage intellectual independence and self-reflection;
- Provide opportunities to experiment or engage in serious play;
- Encourage collaboration of specialist knowledges;
- Provide support networks or advocates to encourage and communicate ideas; and

- To reward divergent thinking and risk-taking.

Organisations such as Pixar and Google value their role in creating an environment conducive to creativity. They provide spaces where people can make connections. For example, such organisations are more relaxed about the ways that people look and behave. They create places to meet and share ideas, to be relaxed and inspired. They are flexible enough to facilitate people who want to work through the night or eat cereal in the afternoon or want to recreate their workspace. There is also considerable research that some level of conflict and stress is useful for generating good ideas.

'Blue sky thinking', or pure research, is valued because it may offer a new idea, property or potential for future development, which is why major corporations allow their employees time to work on their own projects and accept risk-taking. For example, at Du Pont, it is expected that 250 ideas are needed to produce one major marketable product while at Pfizer, 100 possibilities produce one good idea. This is supported by R&D, which sees 3% of sales money at 3M, and 14%, at Pfizer (Kao 1997). At 3 M risk-taking is considered core business: 80% of all sales must come from products less than four years old, and staff can spend 5% of their time on their own projects. Dupont allows employees one day a week; Xerox has weekly meetings in bean-bags to take turns discussing ideas. These companies offer such creative group opportunities to encourage people to be open to serendipity (Kao 1997). Xerox famously invented the first user-friendly mouse-controlled computer, graphical interface, laser printer and local computer network, which is a testament to their creative environment. What they did not do, however, was to follow through on these to become successful innovations, enabling other firms to produce them for the mass market.

Recent Developments: Dynamism, Paradox and Affect

The Five A's

Another version of Rhodes' 4Ps is provided by Vlad Petre Glăveanu (2013), who works from the perspective of sociocultural psychology to develop the five A's framework. Inspired by developments in the psychology of creativity, particularly theories of the distributed and

extended mind, and ecological psychology, Glăveanu's five A's comprise the elements of "actor, action, artefact, audience and affordances" (Glăveanu 2013, 70). Glăveanu advocates the incorporation of multidisciplinary insights and seeks to move beyond "isolated components" such as 'person' and 'product', to the interaction of elements via a systematic, dynamic and contextual approach. Cultural or sociocultural psychology has emerged since the 1980s and is currently a "rapidly expanding" branch of the discipline that draws together psychology, anthropology, sociology, linguistics, history and the natural sciences. Cultural psychologists focus on the "'cultured' constitution and expression of the human mind" (2013, 70). Mental processes are not seen to take place "exclusively in the head" but to be "situated and distributed between brain and body, person and environment" (2013, 70).

Glăveanu's five A's model addresses the limitation that person, process, product and press can be studied as discrete elements, and that there is little within the 4Ps framework that intuitively connect one element to another. In addition, the 4Ps have typically been studied in ways that "decontextualise creativity" and obscure social and cultural elements. To counter this tendency, Glăveanu takes an interactive approach to the language of creativity, moving from 'person' to 'actor', from 'process' to 'action', from 'product' to 'artefact', and from 'press' to 'audiences' and 'affordances'. This suggests a change of epistemological position, whereby "the actor exists only in relation to an audience, action cannot take place outside of interaction with a social and material world, and artefacts embody the cultural traditions of different communities" (2013, 71). From a sociocultural perspective, Glăveanu's five A's framework can be summed up as follows: "Creativity is concerned with the action of an actor or group of actors, in its constant interaction with multiple audiences and the affordances of the material world, leading to the generation of new and useful artefacts" (2013, 76). New questions about creativity arise from the dynamic intersection between various elements in the framework.

The Dynamic Definition

When discussing creativity, there is a tendency to equate creativity with creation and to focus on creative outcomes. However, Giovanni Corazza describes the creative *process* as "dynamic" and as producing "typically multiple outcomes over time" (Corazza 2016: 265). According

to Corazza, potential inheres *within* the dynamism of creativity itself (Corazza and Glăveanu 2020). Chetan Walia (2019) distinguishes between creativity (the act) and creation (the result) and argues that one key limitation of not distinguishing between the two is that inadequate attention is given to "the dynamic process of creativity that may or may not lead to creation" (2019, 237). Glăveanu (2019a) reinforces this point in his discussion of creativity and wonder. Wonder and wondering highlight the complex dynamic between the "actual (what is here in a situation) and the possible (what is not-here or not-yet-here)" (Glăveanu 2019a: 172), which is the basis of creativity. Creativity is "a process meant to materialise the possible in various forms" (ibid.). For Glăveanu (2019a), the dominant focus in studies of creativity on "what is" in terms of a finished product or ongoing processes obscures possibilities for engaging with "what is not (yet)" and "the process of exploring what is possible".

Walia (2019) proposes a dynamic definition of creativity that gives insight into the creative act itself, an aspect not necessarily featured in earlier definitions of creativity. The objective is to separate creation and creativity, and to define them dynamically, while establishing connections between the two. Thus, creativity is defined as "an act arising out of a perception of the environment that acknowledges a certain disequilibrium resulting in productive activity that challenges patterned thought processes and norms, and gives rise to something new in the form of physical object or even a mental or an emotional construct" (Walia 2019: 242).

One disadvantage of studying *creativity* as identical to *creation* is that creation can be only judged when it is concluded, whereas creativity is operational throughout the process and may even continue when an idea or product has been created. Walia suggests that to grasp the nuances of "what produces the 'new', we must separate creativity (the act) from creation (the result), and consider them as different, interactive elements that comprise "a creator's journey" (2019: 239). As a point of departure, Walia points out, following Nakamura and Csikszentmihalyi, that to be identified as a creator, the creation that is produced must be acceptable within the field and the domain. This implies an interplay between three dynamics: *creativity*, *creation* and *the creator*. *Creativity* functions "as the originator of an idea or a variation"; *creation* pertains to the outcome of creativity, and the creator is "someone who interacts with the field and the domain to perpetuate the creation" (Walia 2019: 238). Walia

also suggests reviewing the established definition of creativity that stresses novelty and usefulness, since these aspects offer little insight into "what constitutes or leads to an act of creativity itself" (2019: 239). Furthermore, as creation is the outcome of a range of intersecting variables, it cannot be defined or understood only in terms of the "big achievements and successes" explained by the Four-C model (Kaufman and Beghetto 2009).

Along with effectiveness, Giovanni Corazza (2016: 262) adds the concept of potential originality to his definition of dynamic creativity. For Corazza and Glăveanu (2020), potential is defined as "a mental projection of a present reality onto a possible future, hence a form of forecast, foresight or anticipation" (2020). Corazza suggests making space for *creative inconclusiveness* which can alternate with creative achievement and co-exist with it across different cultural domains (2016, 265). The dynamic definition of creativity proposed by Corazza is: "Creativity requires potential originality and effectiveness" (2016, 262). Walia argues that even though Corazza's use of the word "potential" differentiates between creativity and creation, it does not "dynamically describe what creativity is in itself" (Walia 2019, 239). To illustrate how understanding the elements of creativity helps us to appreciate the dynamics involved in the creative process, Walia works with the hierarchical framework for the study of creativity proposed by Runco and Kim (in their own work published in 2018), who differentiate creativity and creation by expanding Rhodes' 4Ps model of creativity to include creative potential and creative performance. Runco and Kim propose a six Ps model comprising person, process, place (or press), product, persuasion and potential (Walia 2019, 243). Walia shows how the process of creative performance and creative potential connect "through dynamic interactions between various components within the dynamic definition of creativity" (2019, 244). A dynamic definition of creativity is flexible enough to include emotional or mental constructs as outcomes.

Emotion and Affect

Affective dimensions impact the intensity of creative encounters. For Deleuze and Guattari, an affect is an "intensity corresponding to the passage from experiential state of the body to another and implying an augmentation or diminution in that body's capacity to act" (1978: xvi). Affects are "visceral forces beneath, alongside, or generally *other than*

conscious knowing, vital forces insisting beyond emotion—that can serve to drive us toward movement, toward thought and extension" (Seigworth and Gregg 2010: 1) or perhaps "suspend us" and prevent us from acting. Creative encounters reveal our *capacity* "to affect and to be affected" (Seigworth and Gregg 2010: 2). Glăveanu (2019a) describes the relationship between wonder and creativity, explaining that wonder involves an awareness of the expanded possibilities for thought and action that includes both surprise and receptivity. Thus, wonder is an intensity that places us at the dynamic intersection between what is actual *and* what is immanent, potential or yet to come: the pure dynamism of becoming creative. It is an affect that *enables* creativity as an event of becoming other: an intensity that impels us towards new ideas and new ways of thinking.

Glăveanu's work reflects on both the "possibilities of the experience of wonder" *and* "its primary role within creative thinking" (Wurth 2019: 130–131). Wonder creates space for what is possible by opening us to "difference". For Glaveanu, "to wonder means to productively engage with the possible by occupying a 'meta-position', which defines the capacity to 'entertain more than one perspective on reality but, mainly, to view that multiple perspectives are indeed possible.' Such a meta-position enables creativity and, in this way, the creation of novelty" (Wurth 2019: 131). Wonder implies *openness* to experience, which Dollinger, Urban and James (2004: 46) describe as "the key personality correlate of creativity". Beyond their links to internal motivation, we suggest that the affective dimensions of enjoyment (An 2019) and passion (Kunat 2018) are also important to consider, along with affective dimensions of traits or abilities such as conscientiousness (Kaufman 2018) and temperament such as sensitivity (Bridges and Schendan 2019).

Paradox

Creative contradictions are the focus of a recent special edition of *The Journal of Creative Behavior* (June 2019), which centres on the trope of paradox as a means of engaging with diverse ideas about creativity. According to Wurth (2019), creativity is often described using metaphorical logic whereby disparate elements are combined to produce something different or new. Paradox, on the other hand, utilises "juxtaposition and apparently unresolvable conflict" to unsettle our frames of reference. The 'creativity paradox' edition sought to bridge creativity research

in the social sciences and the humanities. Social sciences have typically approached creativity as a process of the brain, and in relation to socio-psychological processes; whereas, from the humanities perspective, creativity is understood to cohere within cultural practices and artefacts (Wurth 2019). Wurth describes how creativity is often associated with unbounded divergent thinking; however, this does not account for the idea that there is convergence *within* divergence and vice versa. Wurth (2019:130) asks: "Is there an irresolvable paradox at the heart of creativity? Is the creative process about a constant negotiation between binding and unbinding, rule and invention, focus and distraction, rather than unbounded digression?" Other paradoxes that are touched on in this edition include the apparently disproportionate attention given to the outcome of the creative process (product or ongoing process), which we have already touched on in relation to Glăveanu's (2019a) discussion of wonder. Glăveanu (2019b) examines the paradoxical dimensions of "immersed detachment", which focuses on the idea that creators are simultaneously deeply absorbed in their work, and their creative environments, and also detached or removed from them, which affords critical reflective distance. The cultural stories we tell about creativity and creating are also riven with paradox. Stierand et al. (2019) point out that we tend to represent the creative process in terms of stories, usually narrated from a retrospective point of view, and embedded in individual acts of creativity, the mind, the 'moment' and revelatory ideas. The authors contend that creative acts are embedded and embodied, and that grounding the creative process within the 'person' generally fails to reflect larger sociomaterial dimensions like social relationality and playfulness. Sociomaterial narratives of creative action rarely follow a neat narrative arc. Rather, ideas are unpredictable, and acts of creating are messy, complex and haphazard. The concept of antenarrative provides a conceptual framework for considering the dynamism of the creative process, and for accentuating anticipation, imagination and playfulness.

Conclusion

In this chapter, we have sought to demystify not just the process, but the meaning of creativity as commonly understood—or misunderstood. We examined key historical developments in its theorisation that define how we understand and value creativity, particularly in western culture, in our contemporary era. Focusing on the creative process, as well as

internal and external factors that constrain or enable creative expression, we have illustrated the contextual nature of creativity and its relatedness to the prevailing political, economic and social milieu. Changing definitions of creativity illustrate a shift away from the primary importance of the outcome or product of creative activity towards dynamic and processual aspects of creating. This shift is accompanied by critical discussion of affective and paradoxical aspects of the creative process.

In the next chapter, we turn to examining innovation, which is so closely aligned with 'creativity' that is it often assumed to either be one and the same thing, or is the other side of the creative coin. Innovation is commonly thought of as the process of converting ideas into viable commercial products, services or practices. But as the next chapter will show, it is so much more.

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CHAPTER 3

Innovation

Abstract The focus of this chapter is unpacking what is meant by the term 'innovation' and explaining how to optimise opportunities to innovate. As such, we explain the importance of culture, identify the main types of innovation, consider the significance of collaboration and team-building, and how to build a culture of innovation. The chapter draws on examples to demonstrate the importance of innovation when confronting a whole range of human issues, particularly the COVID-19 pandemic and climate change. The final section examines key factors that enable or inhibit innovation cultures, including physical and social spaces, incentives and creative constraints, and how to foster an environment that encourages risk-taking and experimentation.

Keywords Innovation process · Teams and team environments · Disruption and crisis · Collaboration · COVID-19 · Climate change

Introduction: Innovation and the Prosperity of Nations

It is conventional wisdom to most people that cultures that value and nurture innovation reap economic prosperity. While it is almost always spoken of in positive terms, the truth is that innovation has often been

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discouraged, both overtly and subtly, throughout much of human history. There are two conflicting reasons for this. Firstly, innovation is typically associated with changes to the status quo in a process popularised by Joseph Schumpeter as 'creative destruction' (Dodgson and Gann 2010, 20). Secondly, societies are usually controlled by institutions that favour a ruling class, which is happy to maintain the status quo of extracting wealth from the many, while the many are discouraged from quelling their exploitation. For example, Pliny the Elder wrote about a man who demonstrated his invention of unbreakable glass to Emperor Tiberius, who asked if he had told anyone else about it. When the man replied no, Tiberius had him dragged away and killed, 'lest gold be reduced to the value of mud' (Acemoglu and Robinson 2012, 171). Aside from violence, what this demonstrates is the central role that governing bodies play in innovation. A ruling body may assist in the adoption of products that appear to pose little or no risk. For example, in Europe, opportunities for exploration and trade were opened with state support for the maritime industry, whereas in China, international trade was banned because emperors of the Ming Dynasty in the early fifteenth century viewed it as a threat to their rule (Acemoglu and Robinson 2012, 232). Similarly, Johannes Gutenberg's invention of the printing press in 1445 was allowed to be replicated across Europe, which led to increases in literacy and education. However the Ottoman Empire banned or tightly regulated presses because their Emperors viewed losing control of knowledge as a threat to their authority (2012, 215).

These examples demonstrate that without central government support and the provision of a safe, stable infrastructure and environment for innovation to flourish, innovation-led prosperity is unlikely. This is still the case today in many countries. Innovation requires systems of government and economic institutions to reward innovators for their creativity, risk-taking and effort. As an economic system, the form of capitalism that is embraced by the majority in our contemporary world is one that encourages innovation. The system is fundamentally driven and entirely dependent upon innovation because the means of production and distribution are privately owned. As Schumpeter explains, the 'fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organisation that capitalist enterprises creates' (Schumpeter and Stiglitz 2010, 72–73).

In other words, innovation is not just necessary in the modern economy but critical to the prosperity of nations.

Niccolò Machiavelli, the Italian diplomat who is best known for his political treatise *The Prince*, recognised that a reformer's dilemma lies in resistance to change and the human desire to preserve the status quo. As he wrote:

> [i]t ought to be remembered that there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things, because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new. This coolness arises partly from fear of the opponents, who have the laws on their side, and partly from the incredulity of men, who do not readily believe in new things until they have had a long experience of them. (Machiavelli 1998)

Machiavelli implies that humans are comfortable with familiarity and inherently suspicious of change. Although necessary, innovation can be uncertain, disturbing established relationships and dynamics of power. Machiavelli (1998) suggests that with experience, people may come to accept novel practices and ideas, especially if change occurs methodically in the fullness of time, enabling the new order to replace the old. A different temporal perspective is offered by Austin et al. (2020) who highlight the contextual nature of innovation and frame the need for change in relation to crisis and the urgency of survival. As they note with cogency:

> Proverbial wisdom says necessity is the mother of invention. But crisis is at least a grandparent because it forces creative minds and bean counters alike to address necessity with fresh eyes. (Austin et al. 2020)

Therefore, fundamentally, innovation is understood quite simply as the creation of the 'novel' or something new. This is how creativity typically precedes innovation and creativity and innovation are often intertwined.

The history of human progress has been driven by the capacity for creativity and innovation. The link between creativity and innovation, reflected in the scale and rate of social and economic change, became evident over a century ago and has accelerated exponentially this century thanks to the integration of and increasing reliance on digital technology. The product of creative endeavour is an idea, a theory or artwork that

allows a patent, book, design or sculpture to be valued, such that it involves intellectual property rights, financial contracts and insurance. Some ideas can be implemented immediately while others take longer to develop. This process of converting creative ideas into viable—and often commercial—products, practices or services lies at the heart of innovation.

This chapter begins with the importance of culture, identifies different types of innovation, explains the significance of collaboration and team-building, and proposes some ways to build a culture of innovation. There are three different types of innovation, broadly referred to as incremental, radical and disruptive. As the process of innovation demands a broad range of specialist skills, and typically involves organisations, the innovation process relies on collaboration between people with different knowledge and skill sets. The chapter draws on examples to demonstrate the importance of innovation when confronting a whole range of human issues. As this chapter shows, combining different specialists brings diverse approaches and working styles to bear on the issue or problem at hand. Key factors that constrain or enable an innovative culture, including physical and social spaces, incentives and creative constraints, and how to create an environment that fosters risk-taking and experimentation, are also considered. We explore the relationship between innovation, disruption and crisis, particularly regarding the COVID-19 global health emergency and the discourse of climate change, both large-scale disruptive forces causing unprecedented levels of uncertainty. The final section of the chapter returns to how to build a culture of innovation by examining the key factors that enable or inhibit an innovative milieu, including physical and social spaces, incentives and creative constraints, and how to foster an environment that encourages risk-taking and experimentation.

Innovation as 'Necessity with Fresh Eyes'

Knowledge and ideas are synonymous with innovative practice, which typically incorporates new technology or new ideas in conjunction with economic, organisational and social dimensions (Meissner and Kotsemir 2016, 3). Dodgson and Gann describe innovation as "ideas successfully applied in organizational outcomes and processes" (2010, 14). On a practical level, as Dodgson and Gann note, innovation generates original products, services or organisational processes (2010, 14). According to Dodgson and Gann, innovation can also be conceptual, offering improved knowledge and judgement. At the same time, it has been noted that the

term 'innovation' is often overused and, as a result, has lost its significance. For example, American academic and author, Scott Berkun prefers the phrase "significant positive change" (2010, xvii).

The 'practice' of innovation can thus be deemed the application of necessity with fresh eyes, or significantly new ways of thinking and doing (Austin et al. 2020). We need to be aware, however, that most innovations are incremental rather than radical or disruptive. Dodgson and Gann describe incremental innovation as "ideas used in new models of existing products and services, or adjustments to organizational processes" (2010, 14). They suggest that this mode of innovation is demonstrated by updated editions of software packages or adaptations that are made to the composition of marketing teams. In contrast, radical innovations alter the character of existing services or products. For instance, the development of synthetic materials such as nylon or the promotion of open-source software radically change human practices. Transformational innovations would typically refer to 'cutting-edge' technologies like the Internet or the use of oil as a source of energy that have a far-reaching impact on human life (Dodgson and Gann 2010, 14).

Innovation process models have clarified our understanding of innovation and how it works. A key understanding is that rather than being an end point or a result, innovation is a process and flow of activities that aim to solve a known or unknown problem. As has been noted, the "problem, as well as its societal implications at different levels, may or may not be widely understood" (Meissner and Kotsemir 2016, 14). Innovation has typically been represented as a process involving specific activities. Linear models of innovation generally comprise a sequence of phases beginning with discovery or invention. The next step highlights utilisation and defines how the results of innovation can be applied. The final stages involve the development, design and practical use of the innovation.

Although equated with the outcome of a process, the trajectory of innovation is not necessarily linear. Whereas a typical sequence of activities is often involved, there are also feedback loops and diversions. As innovators define the problem and refine solutions, it is not unusual for them to move in a non-linear fashion between steps and activities. Studies reveal that attention has traditionally been given to activities in the latter rather than the earlier stages of the innovation process (Dziallas 2020, 502). Judgements about the success or otherwise of innovation characteristically occur later in the process when a product, service or idea has been developed and is ready to be trialled or, later still, as part of post-adoption

review. This is significant because the "front end" or early stages of innovation are now the subject of critical attention, and some organisations and companies are developing front end evaluation capacities.

The alignment of people and activities in the innovation process is reflected in the traditional distinction between invention and innovation. Whereas invention is usually associated with the generation of new ideas, innovation often relates to the conversion of ideas into marketable products, which are often commercially rolled-out, but not exclusively so. In accordance with this distinction, scholars who study invention have given attention to knowledge-based processes, such as factors that affect the production of new ideas, while those studying innovation have taken a management focus, prioritising resources, commercialisation and marketing (Vinokurova and Kapoor 2020, 2373–2374). Until recently, contextual factors such as human resources and company culture were not central to discussions about innovation. However, these are now primary facets of an open innovation paradigm. This paradigm posits that in addition to an organisation's internal culture and resources, multiple external sources impact innovation, including the general public, customer feedback, published patents and a range of external agencies (Meissner and Kotsemir 2016, 14).

The Innovation Imperative

It has become accepted wisdom that our contemporary era is marked by uncertainty and peril. There is a prevailing sense that innovation is required for human and indeed, non-human survival. Yet, it would be imprudent to view innovation as a panacea or an alternative to individual and collective action for strategic structural and social change. We would be wise not to place unreserved faith in innovative technological solutions to global problems like the COVID-19 pandemic or climate change. Innovation is contextualised within, and responsive to, specific cultural, historical and environmental conditions. Arguably, in the present context, *all* innovation is anthropogenic in that to some extent it engages with or to some extent considers human-induced climate change.

The discourse of climate change tells us emphatically that our present world is contending with serious ecological challenges. The Australian scientist and regenerative farmer, Charles Massy, opines that "we have entered a new, dangerous era for life on earth. Human activity has begun to overwhelm the great forces of nature, placing virtually all

life – including that of humanity – at grave risk" (Massy 2019, 247–248). Another well-known Australian scientist, Tim Flannery, concurs and warns that we have been sleepwalking and that the "climate clock" is about to strike "a catastrophic midnight" (Flannery 2020, 179). Tamson Pietsch and Frances Flanagan (2020, 252) lament that while the primary "challenge of our era is to find ways to respond to the ecological, social and political breakdown our world is facing", citizens may be ill-equipped to imagine an effective response. In this context, they suggest that historians can play a valuable role as "community builders" who can forge connections between the past and the present in ways that help preserve citizenship and democracy. They argue that there is no collective or authority with "a democratic mandate and the capacity" to direct us beyond the present malaise and to offer insight into how we might "live together in our common home" (2020, 252–235). In these circumstances, a contest emerges between fatalists who view the crisis as a "technocratic management problem" and those who are willing to envisage "alternative orders and versions of human subjectivity that may be brought into being at the speed and scale required" (Pietsch and Flanagan 2020, 253). We argue that what Pietsch and Flanagan describe in relation to the perils of climate change is the imperative to innovate. We must innovate toward sustainability, which involves conserving resources, caring for the environment and living within our means.

Against the backdrop of climate change, individuals and agencies are offering timely and compelling guidance for innovative change and action. For example, in Australia, the Climate Council released a series of reports that offer scientifically informed guidance: Clean Jobs Plan (2020), *Primed for Action: A Resilient Recovery for Australia* (2020), and *Aim High Go Fast: Why Emissions Need to Plummet This Decade* (2021). In *The Climate Cure: Solving the Climate Emergency in the Era of COVID-19* (2020), Flannery draws on Australia's response to the COVID-19 pandemic in 2020, adding a hopeful rejoinder to public discussion at the time. Outlining a blue print for a climate cure, Flannery gives "a common-sense rapid pathway forward" and "deals with the full range of consequences that are upon us" (2020, 18). Among other things, he suggests that the pandemic has demonstrated our capacities to collaborate in times of crisis. Governments have shown they *can* act decisively upon scientific advice and, according to Flannery, must now apply this approach to climate change. Although the climate emergency is "slower burning" (2020, 151) than the pandemic, and its effects to

this point have generally been less obvious, he contends that Australians are increasingly cognisant of the gravity of the climate crisis and calls for urgent innovative action.

Similar support for innovative action is given by the International Energy Agency in its report *Net Zero by 2050: A Roadmap for the Global Energy Sector* (International Energy Agency 2021). This report, by the world's leading intergovernmental energy agency, provides stringent guidelines for the achievement of net-zero emissions by 2050, based on a transformation of the energy systems that currently sustain our economies (International Energy Agency 2021, 3). Clear milestones are outlined for the transition in the global economy from fossil fuels to renewable energy sources. In addition to innovation, emphasis is given to investment, policy design, technology, infrastructure and international cooperation. The report advocates for the global acceleration of innovation to assist these targets and advises governments to rapidly increase spending on research and development. While existing technologies can be deployed towards net-zero emissions between now and 2030, the report states that by 2050 "almost half the reductions come from technologies that are currently only at the demonstration or prototype phase" (International Energy Agency 2021, 15). Opportunities for innovation will be particularly strong in "advanced batteries, hydrogen electrolysers, and direct air capture and storage" (2021, 15). Whereas large-scale innovation of this kind has a vital and clearly global reach, possibilities also abound for innovation on a smaller scale.

The discussion of innovation so far highlights the view that in these greatly contested times, from the individual to the local to the global, the mandate for innovation is not so much to *recast or remake the world* as to *become with it* to forge sustainable equilibrium. The question of whether this is achievable is the theme of a 2021 edition of the *Griffith Review* titled 'Remaking the Balance':

> As the world teeters between old and new ways of doing, can we remake the balance between what we need and what we nurture? Can we forge a new equilibrium to sustain us into the twenty-first century? Having challenged so much – social practices and social structures, habits of mind and habits of leisure – will the pandemic leave a lasting legacy on how we shape the world? [This edition] examines how our natural, economic and cultural systems might be refashioned post-pandemic: will it be a return to business as usual, or can we reinvent our relationship with all that is animal,

> vegetable and mineral to create a more sustainable future? (*Griffith Review 71* 'Remaking the Balance' 2021)

The questions posed in this description are significant from the perspective of innovation because they provide cues for an unpretentious appraisal of the circumstances at hand, thus offering an important point of departure.

There are certain caveats that should accompany innovation. It is important, for instance, that innovation is ethical and, as far as possible, reflective of individual and public consensus. In fact, consensus may not be ideal for innovation since multiple creative options are needed to generate the diverse ideas from which the best innovations emerge. However, it is reasonable to expect that for innovation to work for the common good, it should represent the interests of all stakeholders involved rather than benefitting a privileged few. One obstacle that can arise when addressing pressing problems is that as crises deepen, public opinion tends to polarise and divide (Cunningham 2021: 129). According to Sophie Cunningham, we may be reaching the point where "the conditions for consensus will no longer exist" (2021: 129). Cunningham argues that we should endeavour to work together despite not always agreeing. This might involve big-picture points of agreement, such as the desire to protect our families, communities, lives and homes. Innovation can proceed ethically based on broad consensus. As mentioned previously, perhaps today we need an approach to innovation based on an ethics of care and connectedness, and the sustainable restoration of balance, rather than radical reinvention. In this regard, innovation might facilitate humanity's *becoming with* the world instead of domination over or separation from it. Ultimately, this calls for innovation that is grounded in empathy, humility and self-awareness.

Speculating the Future: Innovation and Imaginative Engagement

Science fiction novelists often imagine technologies and products long before the expertise and infrastructure are available to create them. Fictional speculation forges a productive alignment between reason and imagination, enabling expanded visions of our future. Historically, the genre has accurately predicted innovations and social trends. For example,

Edward Bellamy anticipated the credit card in the novel *Looking Backward* (1888). The Newspad, a foolscap-sized device that scans the earth's major electronic newspapers in Arthur C. Clarke's *2001: A Space Odyssey* (1968), is widely compared to a contemporary tablet personal computer. John Brunner predicted electric cars in *Stand on Zanzibar* (1969) and in *Cyborg* (1972) Martin Caidin imagined bionics (Contreras 2017). These and many other examples of speculative fiction encourage us to engage with and reflect on innovation and relevant social, political and ethical implications.

More recent examples of speculative fiction construct future social worlds beset by the effects of the COVID-19 pandemic or climate change. Often dystopian in nature, these texts imply the need for urgent innovative action *in the present*. Their exploration of themes such as climate change, contagion, species extinction, resource depletion and forced migration often suggests that existential peril may have been avoided or lessened through prior application of creative and innovative problem-solving measures. A prescient example is offered by science fiction author Kim Stanley Robinson in his novel *The Ministry for the Future* (2020) which documents a world where a climate catastrophe impacts key dimensions of life in India, including the economy and environment. In his analysis of the novel, science fiction researcher J. R. Burgmann contends that preparation for the future necessitates that we clearly and objectively perceive the present. As Burgmann explains, "Only then, by extrapolating the likely future of our planet, might we begin to imagine a better world" (Burgmann 2020). Science fiction can thus be construed as the 'realism of our time' (Robinson 2020), an emerging sensibility based on people's awareness that they are constructing human history through the shared practices of their everyday lives. In this context, it would be naïve to assume that innovation, technology or market-based solutions offer a panacea. Today, we are creating problems that will be impossible for coming generations to solve, as Robinson (2020) notes: "You can't fix extinctions or ocean acidification, or melted permafrost, no matter how rich or smart you are". However, as Robinson's novel attests, we are just as capable of solidarity and can work collaboratively and innovatively to review and reform ideologies, policies and public institutions. Samuel Alexander argues that the future will probably be fashioned by a combination of "design" and "disaster". Rather than waiting for the future to shape us, we should seek to "constitute the future" through planning and

collaborative action (Alexander, in Cunningham 2021: 125–126). Prioritising *design* reinforces the role of innovation in the creation of positive futures, both locally and on a global scale. Innovative steps that are tentative, grassroots and comparatively small can contribute to a sustainable world.

Authors of non-fiction also draw on speculative scenarios to accentuate problems requiring innovative solutions. They may choose illustrative fictional examples to refer to the prospective style of the science fiction genre. In Australia, the Climate Council is considered a leading organisation in the *communication* of climate change. Although predominantly scientific in emphasis, its report *Aim High, Go Fast: Why Emissions Need to Plummet This Decade* (2021) includes a section titled "Australia in a 3 °C World" (44–45), which anticipates life in Australian towns and cities if warming rises consistently above 2 °C and exceeds human control. It is sobering reading precisely because it encourages us to *imagine* the practicalities of life in an overheated environment.

Ethical entrepreneurship is another subject explored through creative and innovative speculation. Australian businessman and philanthropist Andrew Forrest gives a timely example of the connection between innovation and speculative fiction in his 2021 Boyer Lecture series: *Rebooting Australia: How Ethical Entrepreneurs Can Help Shape a Better Future*. Forrest argues that collaboration between business and philanthropy can drive positive change. In his second lecture, "Lighting Up Our Ocean", he contends that unprecedented levels of philanthropic and governmental intervention are required to save the world's seas from pollution, overfishing and deoxygenation. At the conclusion of his lecture, Forrest draws on the plot of a science fiction narrative recently developed by marine researchers who were speculating on prospects for the world's oceans. In their story, a company has bioengineered a species called Super Tuna that is herded along migration routes by underwater drones. Forrest compares this dystopian image to the large-scale netting of wild baby Bluefin Tuna that are conditioned in floating farms in Australia for the export market. He cautions that innovation has brought us to this "absolute nadir of ocean exploitation" and suggests that it is now time to stop and reflect on ways we might act in the ocean's defence.

Future projection is the defining characteristic of some of the world's most significant innovations. Certain ideas are so complex or groundbreaking that no single individual could possibly bring them to fruition. Aviation is a prime example; it took millennia for the idea of flying to

be applied in practice. Four hundred years elapsed between Leonardo da Vinci's illustration of a flying machine and the innovative implementation of flight. The analogy of flight is aptly applied to the uncertainty of the present times by Hunter Clemens, director of meetings at the American Physical Society, who compares providing quality virtual experiences for scientists to "flying an aeroplane while you're building it" (cited in Remmel 2021, 186). Many specialist areas had to be developed before flying could become the global industry it is today. This demonstrates that innovatively engaging with complex problems involves multiple approaches and is often forged through the collaborative endeavours of people with diverse interests, experiences and expertise.

Innovation, Crisis and Context

Crises bring change that encourages innovation. Over centuries, disruptive events have challenged social, political and economic stability and also stimulated progress. For example, although the Great Depression was a period of severe economic decline, for some companies, it presented opportunities for research and development that facilitated future success (Cervantes 2020). DuPont invented nylon and neoprene and P&G (Procter and Gamble) diversified its market, producing serialised daytime radio shows in the Soap Opera genre (Cervantes 2020, 44). Innovative responses to the September 11 (2001) terrorist attacks in the United States presented similar opportunities and hastened the development of some technologies that were already underway. For example, in the wake of the attacks, iRobot Packbots produced by DARPA were mobilised to help search for survivors in the rubble of the Twin Towers. Subsequently, Packbots and other remote control and semi-autonomous robots have been employed in military, crime-fighting and disaster situations, including in the aftermath of the Gulf oil spill (2010) and the Fukushima nuclear reactor meltdown (2011). Since 9/11, advances in social networking and crowd journalism have assisted with the rise of the digitally equipped citizen reporter, and innovations in automatic translation software have aided communication in the military field. Design adaptations have been made to multi-storey buildings and CT scanners for airport security (Eaton 2011).

More recently, the COVID-19 pandemic set a new benchmark for our collective understanding of global crisis (Chopra 2020). It is a "systemic jolt" that has intensified openness to innovation and compelled

innovators to "address necessity with fresh eyes" (Austin et al. 2020). Global responses to COVID-19 saw innovation occurring on an unparalleled scale, the supercharging of entrepreneurial activity and an easing of "bureaucratic, regulatory, and mental" barriers that encouraged innovations such as "remote medical visits and mass virtual work" (Austin et al. 2020). The need to adjust rapidly to changes in how we interact, work, learn and communicate has required people of all ages to engage with technology (Cervantes 2020). In terms of business and corporate culture, innovative output can be maximised during times of crisis. Companies are forced to prioritise and to redeploy their resources in targeted ways. Since time is short, and intensive problem-solving key, expertise is mobilised from across the workforce, which can result in enhanced collaboration, incorporating experimentation and diverse ideas.

For many, technology was already a well-entrenched aspect of daily life, and the pandemic created opportunities to learn new skills and refine existing knowledge. For others, the capacity to work and learn from home during the pandemic was less assured, making access to technology (including its supporting infrastructure) and technological skills a matter of social equity. The disruptive impact of COVID-19 is clear in transformations in professional practice and service delivery in medicine and public health. According to John Nosta, while the COVID-19 pandemic accelerated the rate of change, a dynamic of adaptive thinking is emerging in medicine, for example, that aligns with the development and use of technology. Nosta predicted that technological innovations and artificial intelligence would shift the emphasis of care, freeing physicians to engage with their patients and to "discover a richer and deeper relationship with medicine and mankind" (2020, 882).

Creative entrepreneurial responses to the pandemic abound, and current consumer behaviour is a useful indicator of prospective trends (Meyer et al. 2020). Companies around the world responded to the COVID-19 crisis by cutting costs and adopting innovative business strategies. For example, hand sanitisers were manufactured by distilleries in Australia, Canada and the United States. Protective gowns and various hospital supplies replaced haute couture and became a priority of fashion companies like Zara H&M, Hedley & Bennett and Trigema (Clark 2020, 511). Hospitals recruited airline staff and members of the Special Air Service, and companies like Philips and Draeger scaled up their production of ventilators to address a critical shortage at intensive-care units. At the same time, a group of businesses in the United Kingdom representing

the aerospace, automotive and medical sectors, collaborated to form the VentilatorChallengeUK Consortium. Businesses such as McLaren, Airbus, Ford, Rolls-Royce, Dell Technologies and Siemens were part of the consortium; their primary goal was to produce medical ventilators for the NHS (Walsh 2020; Ventilator Challenge UK 2020). There was a great demand across the world for personal protective equipment including face masks, and with disruptions to supply chains in some of the countries that produced the equipment, creative adjustments and innovation had to be mobilised.

The pandemic created an exciting landscape of possible innovative futures. It is likely that businesses will continue to explore innovative opportunities, projects and strategies that emerged during the pandemic. Meyer et al. observe that "reputations are built – and lost – during times of crisis, and that as the world moves on companies will be characterised and defined by the responses they took during the pandemic" (2020, 3). They suggest that the production of medical equipment could become standard practice for some automotive suppliers and that service providers will continue to "integrate new online interfaces with their traditional businesses" (2020, 4). Furthermore, Meyer, Pedersen and Ritter contend that it is possible that connections between innovation and citizenship forged during the crisis will be consolidated when the economy strengthens. Companies that have taken socially responsible actions, such as assisting in practical ways with shortages or making financial donations, will continue to develop strong relationships with customers. Similarly, firms that have supported their employees during the crisis will attract and retain talented and dedicated staff. A global wave of people choosing to resign from their jobs at the height of the pandemic in 2021–2022, dubbed 'The Great Resignation', is often associated with firms who did not support their employees adequately or who did not innovate sufficiently.

Innovators should therefore keep in mind the power of crises like the pandemic to unsettle the normalised behaviours of consumers, whether individual customers or businesses. For example, consumers have embraced online ordering and home delivery, which has implications in terms of customer attitudes and expectations (Meyer et al. 2020). Meyer et al. (2020, 5) maintain that many people have become familiar and comfortable with online work meetings and will expect greater amalgamation of virtual and face-to-face offerings in their workplaces. Employees

are also likely to want to capitalise on newly acquired technological skills and to develop this expertise within their work environments.

Meyer, Pedersen and Ritter predict that the post-pandemic world will be distinctive and are encouraged by contemporary evidence of entrepreneurial spirit and ingenuity. Fundamental shifts in business practices, incorporating virtual forms of communication and working from home, have been paralleled by dedicated problem-solving and a commitment to creating innovative solutions. For Meyer, Pedersen and Ritter, at a time of crisis, this combination illustrates corporate citizenship and the willingness of many businesses to prioritise social good over financial profit. It also demonstrates resourcefulness through creative engagement with challenges and the inventive application of limited sources. Importantly, citizenship and resourcefulness can be the basis of "socially aware entrepreneurship" (Meyer et al. 2020, 5).

Social awareness underpins ethical dimensions of innovation in the present crisis. Whereas innovation implies adaptation, and the adoption of new directions, ethical responses can reflect the consistency of enduring principles. Daniel Fleming argues that a time of crisis is "not a time to invent a new ethics. A time of crisis is to hold true to the principles that we think are most important and let them guide us" (Fleming in Carleton 2021). From the perspective of economics, Paul Romer notes that "a crisis is a terrible thing to waste" (cited in Meyer et al. 2020). Recognising and honouring the complexity of the relationship between crisis and innovation involve multiple facets, including values and ethics.

Innovation and Values

Clearly, innovation can unsettle what we assume to be true and cause us to reassess our values. Furthermore, different kinds of innovation can prompt different responses from people at different times (Roberts 2019). This section considers three contemporaneous examples that challenge understandings about innovation and ethical problem-solving: the COVIDSafe mobile phone app (or application), recent developments in model human embryos and drone technology. These examples illustrate the ethical complexities of innovation, highlighting how it can function as both a productive response to particular social circumstances and a challenge to prevailing interests, values and ideals.

The COVIDSafe mobile phone app was introduced in Australia in April 2020 and promoted by the Australian Government as means of

decelerating the spread of the virus and assisting manual contract tracing processes. Smartphone users were encouraged to download the app, which utilises Blue Tooth technology to compile a log of other COVIDSafe app users. When another app user was encountered, the COVIDSafe app logged and securely stored the encrypted reference code as well as the date, time and length of contact. This information remained on the phone for twenty-one days before being deleted, a duration that encompassed the fourteen-day virus incubation period, and the time needed for diagnosis (Australian Government Department of Health and Aged Care 2020). In March 2021, a review of the COVIDSafe app at a senate estimates session revealed that the app, which had cost approximately six and half million dollars by January 2021, had identified eighty-one close contacts in the state of New South Wales, seventeen of whom would otherwise not have been found.

Initially, the app did not work well on Apple iPhones and many Australians who were concerned about security chose not to download it. Downloading the app was voluntary and data was not collected about the users' locations. The Department of Health (Australian Government) assured the Australian public that their personal information and privacy would be strictly protected, and in May 2020, the Privacy Amendment (Public Health Contact Information) Act was passed by the Parliament to further strengthen security measures. Despite these assurances, public uptake of the app was slower than expected, perhaps due to Australia's comparatively low level of infection or the fact that during periods of lockdown, many people resided with others they knew and did not feel the need to trace external contacts (Kelly 2021). Some private companies developed their own contact tracing apps with features specific to their needs. For example, it was reported that resources company BHP introduced the C-19 Tracer mobile application for use in its global operations. The app augmented existing strategies such as physical distancing, temperature checks and hygiene measures. In the case of infection, it was designed to identify the movements of employees, enabling the rapid isolation and sanitisation of specific work areas (Kerr 2020).

Ethical concerns were also raised about the creation of the world's first model of an early human embryo. Developed by an Australian-led international research team, this innovative work is celebrated in the world of medical science for the potential insights it will allow into early human development. Professor Jose Polo and his team from Monash University published the results of their pioneering work in the journal

Nature in mid-March 2021. The model human embryos are created from the skin cells of a human arm. Produced under laboratory conditions by researchers, the cells are programmed to replicate the first few days of human life. The model embryos attach to each other and begin to develop, much like embryos in the uterus; however, they are not natural embryos and do not follow the same trajectory of development. For this reason, these models cannot be considered artificial embryos.

Professor Polo describes the human genome as a library. He is interested in how changes occur in human cells beyond the fundamental structure of DNA and believes that "who we are is dependent on how the smallest, most fundamental pieces of our biology are able to open and close the great books of our genetic library" (Monash University 2021). This breakthrough research will shed light on the early stages of human development, which has been limited to this point because access to human embryos is highly regulated due to ethical concerns. These concerns can be allayed because laboratory-grown blastocysts are not the same as human embryos and, according to scientists, do not have the capacity to become fully formed (Subbaraman 2021, 510). In pregnancy, a blastocyst (an egg after it has been fertilised but before implantation in the uterus) implants in the wall of the uterus at around 7–8 days, the outer layer of cells giving rise to the placenta and the clump inside having the potential to develop into the foetus. While scientists have been able to study the later stages of foetal development using stem cell technology, legal regulations and guidelines from the International Society for Stem Cell Research restrict embryo development in the laboratory to 14 days after fertilisation (Subbaraman 2021, 511).

The benefits of this research will impact studies into infertility, miscarriage, birth defects, as well as those working in the field of IVF and those studying genetic diseases such as Cystic Fibrosis. Despite the distinctive benefits of this research, the innovative work of Polo and his team raises ethical issues that should be considered. Professor Polo is adamant that he has developed a "good model" rather than to intervene in the 'creation' of human life. However, the researchers are mindful that important community conversations need to occur about the status of these models and their ethical use in ongoing research. For instance, while it is the belief of the Catholic Church that life begins at the point of fertilisation, it is also vital to note that the iBlastoid models do not require fertilisation. The issue of how far the models can be used to "model biology" (Mannix

2021) is therefore of primary concern. Whether a model embryo is entitled to the same privileges and protections as a real embryo is another ethical question raised by the research.

Serendipity played a role in the production of the model human embryos. The cells created by Professor Polo and his team resembled blastocysts before their attachment to the uterus; however, "[t]heir development into model embryos was pure serendipity, followed by meticulous science" (Mannix 2021). The team had been working on the manipulation of skin cells to turn them into stem cells. A small percentage of the cells were not responding as predicted and lay dormant until placed together. Four or five days later, the research team noticed that the cells had self-assembled to form small balls. Examining the balls, they found a second smaller ball inside each structure: "the primitive endoderm and embryonic stem cells that would, in a real embryo, eventually become a human" (Mannix 2021). At this stage, Professor Polo stopped the experiment and contacted the university's ethics board. The board deliberated for months before instructing Professor Polo to stop experimenting with the cells until a decision was made about how best to proceed. Mannix (2021) writes that "to many people, the study of human blastoids will be less ethically challenging than the study of natural human blastocysts. However, others might view human blastoid research as a path towards engineering human embryos. This will inevitably lead to bioethical questions".

Further ethical questions are raised by the latest innovations in drone technology, specifically in the field of war. Michael Richardson describes a drone as an "unmanned aerial vehicle" that operates within an integrated system. Richardson's collaborative research project "Drone Witnessing: Technologies of Perception in War and Culture" investigates "the ethical, political and cultural significance of drones" and the "impact of increased reliance on drones in war and culture" (UNSW School of the Arts and Media 2022). Richardson explains that drones have transformed how we *see* and *witness* the world, including "how we decide the events that matter and create our shared 'truth' of what happened" (Richardson 2020). Today, drones help determine the ways we perceive "war, climate change, political protest, and now the COVID-19 pandemic" (Richardson 2020). They also perform significant roles in policing, border surveillance and animal conservation (Richardson 2020).

Drones are "vision machines" (Richardson 2020) that hover in the air and direct images to a point of control. The images they transmit can

be optical or thermographic. Drones also collect data, especially information about altitude, speed and location. While they help to shape "the contemporary aesthetic of war", they are also increasingly associated with "new modes of art, activism, and popular and promotional culture" (Richardson 2020). Richardson's research indicates that the mixture of "aerial vision, remote control and data creation" is altering the way we engage with the world. While footage from police drones can be used in court against those who have allegedly broken the law, drones can also capture vision of state violence that may otherwise have gone undetected. For example, drones bore "witness" to conflicts between police and activists during the Black Lives Matter protests in the United States in 2020. Richardson adds that drone footage of open cut mining, the bleaching of the Great Barrier Reef and images of bushfires, floods and droughts contribute to a visual repertoire that is of national, cultural and environmental significance.

Richardson notes that during the COVID-19 pandemic, the surveillance role of drones has widened to include the policing of social distancing. At the same time, drones have allowed us to witness the pandemic in potentially unifying ways. They have given visual access to city spaces devoid of crowds, and in contrast to the continual regime of testing, statistics and logarithmic information have enabled us "to witness the uncanny, melancholic and strangely beautiful disruption to everyday life" (Richardson 2020). Thus, Richardson argues, drones provide a context for interpreting the "dislocations and anxieties of life under lockdown" (2020). In a particularly creative manoeuvre, a flotilla of drones was used in Seoul, South Korea, to convey aerial public health messaging.

Richardson argues that drones could be instrumental in opening the world to our shared perception in surprising ways as the threat of the pandemic recedes. As Richardson explains, "With millions stuck in lockdown and travel restrictions in place, drone footage shared online can help people experience distant places without leaving home" (Richardson 2020). Richardson cites the example of WeRobotics, who train local operators to undertake mapping and photography in Africa, Asia and South America. Acknowledging that drone technology can have complex social outcomes, Richardson recommends that we expand our engagement with the ethics of aerial vision as it pertains to drones.

Of ethical importance is the capacity of drones to diminish the boundaries between "war and domesticity" and "human and machine"

(Richardson 2020). Strategists generally view drones as having the potential to alter the ways modern war is perceived and experienced. Large drones like the Predator and Reaper "help the US exert power across the globe". Equipped with high-tech surveillance equipment, these drones "can provide support for soldiers on the ground as well as launch their own strikes. And they can do all that without exposing their own crews to danger". According to Richardson, some supporters of drone technology believe that drones help to create safer wars by making them "more technical and precise" (Richardson 2021). While this may be the case, he observes that in recent times, thousands of civilians have been killed in American drone strikes. In Afghanistan, Pakistan, Yemen, Gaza and elsewhere, people have lived with the constant threat of drone attacks and are never sure when the next attack will occur. Furthermore, there is evidence that the use of drone technology can alienate and in some cases, radicalise local people (Richardson 2021).

Concern has arisen in recent times about the ethical deployment of swarm drones. These small devices work in teams, following mission directives to achieve specific goals. At present, research is focused on the capacity of the drones to carry out directives and collaborate to fulfil objectives (West 2021). Surveillance is a concerning ethical dimension of swarm drone technology development, particularly as it relates to consent and the possible violation of individuals' privacy. Ultimately, the technology is designed to act autonomously or without human control. This means that even in a surveillance context, the drones may act in ways that the operators do not anticipate. In future, there is also scope for the swarm drones to be weaponised in the theatre of war (West 2021).

Swarm drones are perfectly suited to mobilisation in high density urban areas. Some of the complexities of urban warfare in built-up areas could be addressed by drones that are deployed in between buildings or manoeuvring through open windows. The capacity of swarm drones to operate within confined physical spaces, to identify targets and to undertake precise offensive action, promises to reduce structural damage to the built environment. Broader ethical concerns relate to the ways new drone technology will support military strategies in the arena of war (West 2021; Richardson 2021). As older drone models like Predator and Reaper become obsolete, advances in computer processing, artificial intelligence and aeronautical design will facilitate a new era of drones better suited to the tactical ambitions of modern warfare. The integration of artificial

intelligence and augmented reality into the military context is well documented. It was recently reported that Microsoft will make thousands of "military-grade augmented reality (AR) headsets" available to the United States Army; these headsets are likely to include thermal sensors, simulation functions for training purposes and a digital display capacity to heighten "situational awareness" (Egliston and Carter 2021).

While much of this technology is yet to be fully developed, the realisation of these military adaptations is reportedly well underway. According to Richardson (2021), drone swarms with the capacity to "self-heal" or to adapt to losses during deployment are an emerging reality, and as Richardson observes, the availability of this military technology presents the potential for war to become increasingly clinical and detached. It also risks placing violent action and confrontation ahead of diplomatically negotiated solutions (West 2021). New drone technology accentuates the need for true social debate about "transparency, accountability and responsibility", the nature of war and the "kinds of weapons we are willing to have used in our name" (Richardson 2021).

Innovation and the Everyday

COVID-19 draws attention to the role of entrepreneurship in a post-COVID-19 world. Dean A. Shepherd argues that the pandemic challenges the validity of assumptions that have been essential to innovation (Shepherd 2020, 1750). For instance, although it is commonly thought that entrepreneurs are the primary drivers of disruption, in the present context, the virus itself is the key disruptor. Shepherd considers how entrepreneurship, whether independent or corporate, will become a part of the so-called new normal. The virus unsettles the perception that technologies and markets operate in a relatively stable environment that is intermittently disrupted by extreme events. In actuality, the increasing regularity and severity of extreme events is a feature of the present context (2020, 1751). The pandemic also challenges the long-established view that entrepreneurs are unique individuals, distinguished by remarkable attitudes and skills. In reality, the pandemic reveals the entrepreneurial potential of "ordinary people" and shows that "entrepreneurial action is possible anywhere" (Shepherd 2020, 1751).

Throughout history, ordinary innovators have created strong links between cultural identity and place. In Western Australia, the WA Museum Boola Bardip features a permanent *Innovations* exhibition,

highlighting local examples of creativity and entrepreneurship in the sciences, art, music, medicine and fashion. In another collection, everyday ingenuity weaves through the historical narratives of individuals and their families. This collection showcases the adaptability and resilience of previous generations of Western Australians, including Indigenous Australians and immigrant families. The formative role of innovation is highlighted within the unique social and historical environment of Western Australia. In times of economic and social hardship, people 'made do' by creatively repurposing found objects. Scarce resources and isolation forced people to work collaboratively and innovatively. One compelling exhibit in the museum features the innovative repurposing of kerosene tins, drums and crates. Kerosene or 'Kero' is a fuel extracted from petroleum that is used for burning in lamps and domestic heaters as well as a solvent for greases and insecticides. The extreme hardships of the 1930s Depression, and World War Two, meant that Western Australians had to take particularly flexible approaches to the limited resources in their everyday environments. For example, many fashioned what came to be known as "Depression Furniture" from Kerosene packing crates and drums. Crates were used by inventive Western Australians in various ways, including to build lunchboxes, children's toys and even houses. In the 1920s–1930s, Kerosene tin buckets were used domestically as well as in mining and agriculture (WA Museum Boola Bardip 2022).

In another context, Gabrielle Chan (2020) describes the nimble responses of people living in small communities in the foothills of the Upper Murray region in Victoria, Australia, following a bushfire. Prior to the fire, Josh Collings from Cudgewa in Victoria, and his fellow community gardeners, introduced a community food swap, which attracted interest from residents in the region. When bushfires swept through their community, the family's cottage was destroyed. Returning to survey the damage, they noticed that the only part of their property that was unscathed was a small patch of zucchinis in the vegetable garden. As they moved through the district, this scene was repeated. Vegetable patches signalled life in the ruined landscape. Taking this as a sign of hope and resilience, Collings started the Acres & Acres Co-op, a combination of community and market gardens. Profits from the sale of produce paid the workers, with the remainder being divided between the cooperative and local initiatives (Chan 2020). More than just revitalising a community, the objective of the Acres & Acres project is to "use regenerative farming practices and world-class small-scale farming innovation to enable local

communities to grow their own food sustainably" (Acres & Acres 2021). The Acres & Acres initiative is part of a wider phenomenon that reflects the desire for everyday people to engage with sources of food production.

Everyday innovators and entrepreneurs unsettle the normalised association between entrepreneurship and isolation. This association is accentuated by the COVID-19 crisis. Entrepreneurs are often represented as solitary figures, while entrepreneurial careers can "generate loneliness" (Shepherd 2020). The pandemic draws attention to the common experience of social isolation. During periods of lockdown, many people have experienced loneliness and found creative ways to stay connected. According to Shepherd, the pandemic has also shed light on entrepreneurial failure. When innovative ventures fail, it is often attributed to the decisions and actions of individuals. In the context of COVID-19, however, some businesses have dramatically declined despite individual input (Shepherd 2020, 1752). The reverse is also true: the pandemic has created opportunities for other entrepreneurial individuals and businesses. In addition, crises encourage collective action, which is the antithesis of lone endeavour, and solidarity in numbers increases the likelihood of success.

Jesse Adams Stein (2017) describes how, in the context of Australian politics, the term 'innovation' aligns with principles of economic efficiency and entrepreneurship. Specifically, innovation "naturalises a way of thinking that valorises profit-making over other social, ethical and environmental considerations". The examples Stein provides take innovation in another direction as well as focusing on innovation in the everyday. MakerSpace & Company promotes the benefits of making by building connections between people with differing levels of skill and experience in the design community. Participants are given access to professional facilities as they collaborate, learn and create (MakerSpace & Co 2021). Freecycle is a global non-profit movement of over nine million members who exchange and reuse items advertised through an online platform; those items might otherwise end up in landfill. Membership is free and people network in their local communities (Freecycle Network 2021). Orange Sky Australia is "the world's first free mobile laundry service for people experiencing homelessness" (orangesky.org.au/our-story/). Initiated in 2014 in Brisbane Australia, Orange Sky now includes shower services and remote vehicles. As well as improving standards of hygiene and boosting the morale of people who are enduring hardship,

Orange Sky volunteers seek to dignify friendship and to challenge negative perceptions of homelessness.

Alternative forms of knowledge, understanding and inquiry are celebrated in the contexts of everyday entrepreneurship and innovation. The practical knowledge and experience of people in local communities can inform innovative responses to complex problems that have traditionally been reserved for science. Although local in focus, the application of this expertise can be global in reach. Environmental scientist, Jessica Reeves, uses the example of Lake Tyres in the East Gippsland region of Victoria to illustrate the importance of multiple approaches to knowledge when preparing to innovate (Taylor 2021). Reeves argues strongly for recognition of the epistemological value of local perspectives and experiences, including Indigenous custodianship, that fall largely outside the methodological parameters of formal Western science. She contends that a collaborative integration of diverse perspectives is needed for innovative engagement with natural systems that by their *nature* are highly interconnected and multi-layered. Essentially, Reeves highlights the importance of combining knowledge from science and art, as well as local and traditional expertise, to enrich collaborative and innovative practices (Taylor 2021).

Technology in Context: Innovation at Work

It is predicted that global innovation will increase to problem-solve in the context of the COVID-19 pandemic. As the world moves forward, Zahra (2021) suggests that, among other attributes, agility, risk-taking and proactivity will be valued as part of an "entrepreneurial orientation". Digital technology will continue to facilitate innovation. For many, initiatives such as online ordering and home delivery are commonplace. Businesses are likely to continue to explore market opportunities based on digital technologies. For example, entrepreneurs from emerging economies have responded to the uptake of smartphones by developing a range of innovative products. Similarly, digital technologies have become central to the survival of "restaurants, retailers, banks, and book sellers" (Zahra 2021, 4).

Recent innovations in contactless technologies in the hospitality industry reveal the multiple dimensions of hospitality. Being hospitable implies the amicable reception of guests, clients and friends; however, the *experience* of hospitality need not rely on sharing physical space. It is possible to be welcoming and inclusive beyond the realm of the

face to face. Technology is being used to ensure safety and maintain consumer trust. Artificial intelligence, visual recognition, robotics and virtual reality are among the technologies transforming this industry and helping to hyper-personalise customers' experiences whilst retaining health security measures (Sanchez-Pardo 2020). Innovation managers are exploring the roles artificial intelligence can play in areas such as data analysis and the clarification of problems (Kakatkar et al. 2020, 178). Innovative technological approaches are being incorporated into standard service operations. Along with hand-hygiene, mask-wearing and physical distancing, touch-free and contactless technologies reinforce health measures and enable patrons to continue their lives with minimal disruption. If hotels are equipped with the appropriate software, clients are now able to access many aspects of the hospitality experience on their personal mobile devices, including "scannable QR codes, contactless hotel check-in capabilities, mobile room keys, touchless payments and in-app ordering" (Rahimizhian and Irani 2020).

Research conducted by Rahimizhian and Irani (2020) sought to discover how tourists responded to innovativeness in their experience of tourist activities during the pandemic. Innovativeness was also used to describe the level of receptiveness demonstrated by tourists to new technologies as part of the tourist experience. Innovativeness reflects the customer's desire to seek novelty, uniqueness and stimulation, as well as their willingness to act independently (Roehrich, cited in Rahimizhian and Irani 2020). Innovative customers are likely to be early adopters of innovative services and technologies (Hadi et al. 2020; Strutton et al. cited in Rahimizhian and Irani 2020). They are often adventurous and value being the first to enjoy novel tourist experiences. Innovativeness also plays an important role in influencing the "revisiting intentions" of tourists (Rahimizhian and Irani 2020). The researchers found that the COVID-19 crisis increased opportunities for innovation in the tourism industry, and that there were competitive advantages for businesses that sought out innovative solutions to the crisis and could transform innovative ideas into practical strategies of operation and management.

Although tourism and hospitality providers face a great challenge attracting travellers and clients to COVID-19-affected locations, Rahimizhian and Irani (2020) concluded that the adoption of innovative technological strategies, implemented in accordance with health regulations, allayed customers' fears and uncertainties. It was possible, therefore, for tourist destinations to continue to attract customers despite

COVID-19. The authors were particularly keen to understand how technology could be harnessed to increase the confidence of customers. They suggest that post-COVID-19, the development of a "touchless, adaptable and customizable automation platform featuring all front-office operations and answering particular business requirements" (Rahimizhian and Irani 2020, 294) could be a worthwhile point of departure and recommend that other innovative automated and contactless solutions could be deployed to reduce uncertainty for customers.

As a result of the pandemic, videoconferencing also became a major focus of contemporary communication practice and played a vital role in workplaces. Video conferencing is now a critical communication tool for hundreds of millions of people. The video conferencing platform Zoom capitalised on the dramatic changes in private and professional communication. The shift from physical workplaces to the virtual office had been anticipated for some time; however, with the arrival of the pandemic, Zoom became a leader in its field. The centrality of video meetings in our lives is reflected by the term 'zooming', which is now as familiar as 'googling' (Bailenson 2021). Zoom recorded a 325% increase in revenue in 2020 at the height of the pandemic (Kelly 2021). While Zoom would have lost market share from 2021, it remains the default videoconferencing platform for the near future.

The popularity of video conferencing brings advantages and risks. One study shows that videoconferencing is more than 10% more energy efficient than face-to-face meetings (cited in Bailenson 2021, 2). In terms of risks, security issues emerged early in the pandemic around the practice of 'Zoom bombing', uninvited participants joining Zoom meetings. The heavy reliance for some people on Zoom meetings has led to 'Zoom fatigue', another aspect of online videoconferencing that has drawn critical attention. Bailenson (2021) applies this term to the nonverbal overload that can result from extended periods of video conferencing. When conducting research into the condition, he selected Zoom for analysis because of its dominance: user numbers increased from ten million in December 2019 to more than three hundred million in May 2020 (Bailenson 2021). Bailenson's research indicates that video conferencing can have psychological consequences, and that Zoom Fatigue is attributed to a combination of eye strain, cognitive overload, increased self-devaluation and reduced mobility.

Innovative approaches to integrating video conferencing and virtual meetings into evolving and future work practices will advantage many

professional organisations. Video conferencing was a successful practical technological response to unprecedented working conditions. Virtual meetings are likely to become an indelible signifier of the COVID-19 experience, characterising the pandemic for many individuals, as well as resonating in the collective imagination on significant sociological and communicative levels. Despite Zoom-fatigue and a reported desire for many employees to engage with colleagues in physical workspaces, there are advantages to virtual conferencing for researchers and businesses. A study conducted by the multidisciplinary science journal *Nature*, based on a survey of more than 900 readers, revealed that moving into the future, 74% were in favour of retaining virtual meetings, or meetings with a virtual component, in the sciences (Remmel 2021, 185). Readers identified flexibility and the opportunity to attend meetings from anywhere in the world as a major benefit of virtual platforms. Many also reported attending more conferences in 2020 than in previous years since it was possible to attend conferences without compromising ongoing work commitments or being disrupted by travel. Some academics reported that 2020 had brought increased opportunities to present their research, and for many, the appeal of lowering their carbon footprint was an added advantage. The lack of opportunities to network with colleagues was cited by respondents as the biggest drawback of virtual conferencing. Especially for graduate students, the relative lack of impromptu interactions at online events made it difficult to connect with future collaborators or mentors.

Innovative solutions to the management of virtual interactions will be the way forward in the context of hybrid work environments. The incorporation of video conferencing and other virtual workplace experiences are predicted to become standard features of blended workspaces in the transition to the *new normal* world of work. Having met the challenge of adapting to the virtual, conference conveners will need to explore creative and innovative approaches to integrating virtual elements into physical workspaces (Remmel 2021, 186). Mentorship programmes that connect early-career science researchers with established academics are being developed online, and virtual lobbies are occurring on conference platforms where attendees can interact with conference presenters.

Continued developments in 'smart' technologies can assist the transition to hybrid workplaces. Typically, these technologies have focused on analytics and the management of workforces; however, possibilities now emerge for products and systems to support the integration of workers with their work environments in ways that accentuate workers'

productivity, safety, collaboration and well-being, while also optimising the organisation's management of human capital and resources. Some recent examples include the use of thermal imaging technologies to detect high temperatures in workplaces that could be a risk to workers' health or encourage viral transmission. Infrared radiation is used in devices in the medical profession to effectively measure temperatures; however, advances such as the use of cameras in workplaces in conjunction with mobile apps enable swift detection of high temperatures that might indicate contagious illness and take it a step further to ensure effective communication.

Similarly, carefully integrated sensor technology can help to regulate the movement of people in larger workplaces. The desire to monitor the shared occupation of interior spaces and the use of lifts and transition spaces are heightened by the pandemic. Innovative use of technology to collect data, and assist reporting, can benefit workplace traffic management by indicating spatial occupancy patterns. The provision of "real-time proximity alerts" adds the advantage of live reporting to help maintain essential social distancing protocols. Other innovative strategies include touchless options to reduce tactile engagement in the work environment. The health risks associated with touching door handles and buttons can be reduced by incorporating sensors and mobile ID scanners. Integrated facial recognition technology and mobile identification devices can add a further dimension of assistance. Occupancy sensors mean that the cleaning of shared bathrooms, kitchens and office desks occurs at the point of need or usage rather than based on routine or schedule. To be sure, there are ethical risks associated with privacy invasion and the normalisation of everyday surveillance that come with the territory of technological innovations. These risks must be addressed carefully without necessarily curtailing innovation per se.

Conclusion

The COVID-19 pandemic has drawn attention to a less grandiose yet no less significant mode of innovation relating to the experiences of the everyday, which is what the chapter has sought to portray and unpack. Many examples of everyday entrepreneurship emerged during the pandemic, often illustrating the temporal distinction between reactive innovation and proactive innovation that addressed longer-term and potentially more complex issues and problems. The pandemic

has required people to respond immediately to altering life circumstances and to be agile and precise when making changes in their lives. Accommodating uncertainty is a dominant aspect of everyday innovation and entrepreneurship. Simultaneously, innovation persists towards the achievement of broader and often longer-term objectives such as the development and dissemination of COVID-19 vaccines and post-pandemic restructuring and preparedness.

One of the most significant aspects of the pandemic from the perspective of innovation is the question of "*what happens next?*". What are the roles innovation will play in shaping the future directions of the world and its inhabitants? Philosopher Danielle Celermajer connects some of the points raised in our discussion in this chapter with the complexities of human responsibility amidst crises. She explains that conditions for both Australia's Black Summer mega bushfires of 2019–2020 and the pandemic "grew in the soil of humans' rancorous relationship with the earth and other earth beings" (Celermajer 2021, 178). Celermajer wonders if it is now possible for us to tell new stories about responsibility; in particular, to "put our names to stories that both recognise the unevenness of culpability and its concentration in particular types of practices and arrangements" (185). This includes genuinely appraising how we are all implicated. Satyajit Das (2021, 439) writes that "[w]ithout drastic action, humanity faces a series of insurmountable challenges" and that ultimately, "everybody has to sit down to a banquet of consequences" (Das 2021, 297). The slow-burn effect of the climate crisis, alluded to earlier, exacerbates inactivity; delay and denial inhibit the adoption of effective solutions. For Das, "[d]isregard for truth, denial and a refusal to acknowledge limits to individual freedoms are at the heart of unwillingness to act" (2021, 433). As a result, advanced technological societies, along with those less advanced, have found themselves "humbled by a primitive organism". Das contends that history offers limited evidence that society will adopt the "necessary corrective measures" and that, "[a]t best there will be adaptations to living under deteriorating physical conditions and constraints" (2021, 439). The key point here is that the first level of response when seeking genuinely effective and innovative solutions is a resoundingly honest engagement with all facets of the problem.

Innovation today needs to be an authentic investment in an everyday hope: that we *can* create equilibrium to sustain us into the future. Such a vision of innovation might allow us to constitute desirable futures

before *undesirable* futures constitute us. When innovating, we should aim to counteract fear without ignoring reality or placating uncomfortable truths. We must be sure to innovate in ways that reflect our changing relationship to the world's finite resources as well as those forces in the world such as our relationships with non-human entities that are less tangible and knowable. We must innovate ethically for social, economic and political equality, finding resolute and meaningful ways to engage with issues of social justice. Innovation should help us embrace uncertainty while placing us in the proximity of productive experimentation and risk. Innovation should allow us to access new worlds or be the portal through which we engage with our familiar but ailing world anew; it should be a medium through which we create sustainable options with the available resources or what we have at hand.

Perhaps most importantly, we should embrace innovation from the perspective that it is *in-process*, ongoing and necessarily incomplete. Dispelling binary positions, embracing transition and positioning ourselves *between* the *old* and the *new* world orders to which Machiavelli refers may provide the flexibility and courage required to innovate for a post-pandemic world.

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CHAPTER 4

Prompts for Creativity

Abstract This chapter discusses a range of creative thinking tools, and presents how these can be used as 'prompts' or strategies to enable, enhance and encourage convergent and divergent thinking that are the hallmarks of creativity and the creative process. The chapter starts by briefly explaining the role of perception in creative thinking. This includes how to develop our ability to think creatively by practicing how to employ ambiguity and contradiction as a part of our thinking. The chapter then discusses a selection of creative thinking prompts, including: asking questions, analogy, assumption surfacing and provocation, attribute listing, brainstorming, the 6 thinking hats, forced connections, lateral thinking, mindmapping, PMI (plus, minus and interesting), reversal and SCAMPER. We explain how these prompts can be used and how they might be beneficial in the generation or refinement of ideas or problem-solving.

Keywords Creative prompts · Asking questions · Analogy · Brainstorming · Lateral thinking · Mindmapping

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Introduction

The desire to generate creative, or even novel or original, ideas is not an uncommon aspiration. It is common to want to find solutions to problems or issues that we encounter. An awareness of different ways we can think creatively and some of the prompts we can draw upon to help with idea generation will assist in breaking through limits to creative thinking or unblocking idea generation. This chapter discusses what might be referred to as "prompts", or strategies, that can be used to enable and enhance creative thinking.

The chapter seeks to identify some of the assumptions about creativity that have crept into our psyches through our social interactions and via popular media. While many of these assumptions have helped us in the way we think about creative responses to all kinds of issues, some ideas can stymy our thinking by narrowing our perceptions. The key thing to bear in mind as we approach this chapter is that there are many prompts, tools and strategies for creative thinking and idea generation. As it is not feasible to explore every single possibility, this chapter will introduce some of the main ones.

We start by briefly explaining the role of perception in creative thinking. This includes how to develop our ability to think creatively by practicing how to employ ambiguity and contradiction as a part of our thinking. The chapter then discusses a selection of creative thinking prompts, including *inter alia*: asking questions, analogy, assumption surfacing and provocation, attribute listing, brainstorming, the 6 thinking hats, forced connections, lateral thinking, mindmapping, PMI (plus, minus and interesting), reversal and SCAMPER. We consider how these prompts can be used and how they might be beneficial in the generation or refinement of ideas or problem-solving.

Perception: Developing Our Ability to Think Creatively

Drawing upon one or more creative thinking prompts can be useful when we need to generate ideas quickly. As well, some creative thinking prompts are useful when we wish to refine ideas or solutions that we have generated. Such prompts reinforce the need to use both convergent and divergent thinking. Convergent thinking, commonly referred to as 'critical thinking', generally refers to the ability to apply logic to

give "correct" answers to standard questions that do not require significant creativity. Common examples include many tasks in school, and on standardised multiple-choice tests used to measure intelligence. Divergent thinking, on the other hand, is synonymous with 'creative thinking'. Divergent thinking typically occurs in a spontaneous, free-flowing, 'non-linear' manner, with the intention of generating more than a single idea. Many possible solutions are explored in the hope of finding new connections and ideas (Cropley and Cropley 2009). It is important to note that convergent thinking is often used in conjunction with divergent thinking, and the combination is sometimes referred to as 'lateral thinking', which contains within it active elements that underpin both creativity and innovation (ibid.).

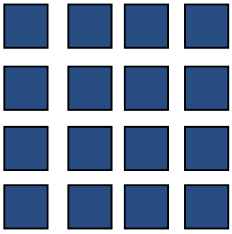
Particular attitudes and habits of mind underpin creative thinking tools and prompts; awareness of these and practicing them may help to develop our creative thinking ability. For example, because creative insights often occur where there are competing or opposing ideas, it is not surprising that creative people tend to employ ambiguity, ambivalence and contradiction as a part of their thinking. As this chapter suggests, many prompts for creativity rely on our ability to employ ambiguity, ambivalence and/or contradiction in our thinking.

Generally, healthy human beings are skilled meaning-makers. The human brain is for most people wonderfully efficient at quickly processing sensory inputs by drawing connections, making patterns and filling gaps. Our brains need to be efficient; they process more than eleven million bits of data through our sensory system every second. Much of this processing work is undertaken either unconsciously or subconsciously. Our conscious self only processes up to 40 bits of information a second (Nørretranders 1998: 124). This gap in conscious and unconscious processing shows that humans store far more information than they are ever fully aware of. Moreover, a functional magnetic resonance imaging (fMRI) shows that the brain lights up, or the brain does most of its work, when there is a gap of some sort. When we do not have all the information, we often register this consciously as interest or intrigue, because gaps trigger our curiosity. The act of resolving this curiosity then triggers the release of dopamine, often referred to as the 'pleasure chemical'. This explains why detective or crime media is so popular, why we can make sense of the 'moving images' and film editing, and why we can read jumbled text. For example, you can actually read this:

> i cdnuolt blveiee taht I cluod aulaclty uesdnatnrd waht I was rdanieg. The phaonmneal pweor of the hmuan mnid, aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it dseno't mtaetr in waht oerdr the ltteres in a wrod are, the olny iproamtnt tihng is taht the frsit and lsat ltteer be in the rghit pclae. The rset can be a taotl mses and you can sitll raed it whotuit a pboerlm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe. Azanmig huh? (Danalookadoo)

We can read this passage because our eyes only scan the outline of letters and we read the pattern. This also explains why it is often easier to read words in lower case rather than upper case. The same happens with hearing: most people do not need to hear every word fully to know what is being said; we use the *context* of what is heard to filter the range of possibilities. The human brain performs the same creative feats with music to create patterning. What these examples demonstrate is that our ability to make meaning, often quite quickly, can sometimes mislead us or foreclose other ways of thinking about it.

Look at the figure below. This is another example of how our brain works to 'fill in' blanks. In this example, you may notice that the 'phantom' dots only appear when we are *not* focusing on them.



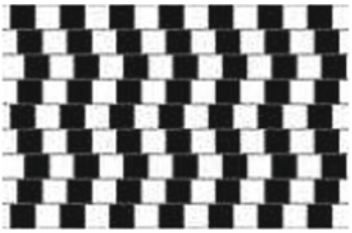
The same thing happens when we try hard to remember a name. We know that the name is most likely to 'come to mind' or 'pop' into our head when we are thinking of something else. These examples reinforce the importance of 'letting go' or recognising when we should try not to force our thinking. Trying to retrieve 'what we already know' can sometimes blind us to what is actually in front of us. Actively trying to retrieve information also encourages us to make assumptions and leap to conclusions, which reduces our ability to see alternatives or ask questions. 'Letting go' allows us to stop and look around, or shift our focus

elsewhere, or to another perspective. For example, imagine the equation below is made of sticks. Identify the least number of moves to correct it.

We can try to use logic and what we know about Roman numerals and arithmetic to solve this equation, but the only way to solve it is to change your perspective, literally. You only have to turn it upside down and the answer is immediately apparent. This example demonstrates two things. Firstly, it is possible to find a solution if we just approach the problem from another angle or perspective. Secondly, sometimes we just need to stop. Lateral thinking is a thinking tool that encourages us to pause. The value of doing nothing is that it can be more useful than making assumptions and leaping to conclusions. Doing nothing forces us to look at the whole, or to approach an issue from another angle.

Travelling also demonstrates the way in which prior knowledge affects what we think we see. This is because we transform what we see into something we can recognise and understand by filtering it through our knowledge and experience. When native North American Indians first saw a European on horseback, it was reported that they 'saw' a strange creature with two heads, two arms and four legs (Hoxie 2013). This was of course a mistaken perspective, but it illustrates the point that we usually see what we expect to see. Here is another example: provide a solution to this problem: 1 ÷ 2. Did you immediately provide a mathematical solution? Did you leap to say one half, or did you express it as ½ or 0.5? If so, what this suggests is that you assumed that the problem required a mathematical solution that you have learned, that there are particular mathematical equations that are correct, and that it is important to get the 'right' answer. This is because humans tend to learn by making, storing and retrieving connections between things—bacon and eggs, table and chair, and mother and father. The more often we repeat a pathway or association, the stronger and thicker it becomes in our brains, thereby allowing us to quickly find an answer.

The following example illustrates this point: describe what you see on the right side of this page.[1] What is presented are back and white squares, but what you see are rows of black and white wedges. What this shows is that when we force a connection between two different or unrelated things, we can create something entirely new. We know that children will easily put together or combine different things such as toys or other playthings. Artists are also more likely to put things together that have no obvious connection to provoke us to respond and think about them. Advertisers and culture jammers do this too.



A schema is the name for a necessary and particularly useful way of thinking that helps us make sense of new information quickly. Schemas help us hold all the bits of random information about 'you', or an event such as New Year, together by making shortcuts that interpret and organise new information very quickly. This means that schemas also help us exclude information that doesn't fit with, or confirm, what we already 'know'. Therefore, schemas also affect the way we think about things. This is because schemas encode incoming information with existing values and attitudes. They affect the attention we give to something and allow us to ignore or discount things that do not fit our schemas (Vinney 2019). This mental framework, comprised of pre-existing ideas, enables us to think and talk in terms of worldviews, stereotypes and ideologies. Being able to develop awareness of such a framework is an important step to being able to think and function more creatively.

[1] "Creative Commons Café Wall Illusion" by Fibonacci is licensed under CC 3.0. (https://en.wikipedia.org/wiki/Caf%C3%A9_wall_illusion#/media/File:Caf%C3%A9_wall.svg).

Trying on Other Perspectives

When we interrupt our automatic drive to make sense of data, sensory or otherwise, we have an opportunity to consciously resolve our curiosity, but in a way that encourages us to observe, question and listen more closely. Sometimes just changing the focus of our attention changes what is seen. Those familiar with Rubin's Vase, a famous set of bi-stable or 'reversing' two-dimensional form-image, also known as the figure–ground vase or the Rubin vase, named after the Danish psychologist Edgar Rubin (1921), would understand what it means to try on other perspectives.[2] Viewers of the image will be primed to oscillate between seeing silhouettes and vases. Initially, we tend to see one or the other because that is what we are used to. Sometimes what we are looking at has not changed one bit, but how we see it or think about it has changed and we see/think quite differently. This example, along with other images by Rubin (1921), shows that humans can see what we do not perceive when we become aware of and practice thinking in terms of simultaneous opposites. It is not easy to hold two ideas simultaneously, however it does get easier with practice. One way to practice is to create paradoxes, for example: lead by following and win by losing. This is also sometimes referred to as Janusian thinking because it reflects the ability to look in two directions at once, like Janus, the two-faced Roman god of beginnings, transitions, time, doorways and endings, who looked to the past and the future.

Innovators often come from fields very different to the field of their invention(s). For example, Louis Pasteur was a chemist who taught himself bacteriology, and was found to be a lover of fine arts all through his life (Hansen 2021). Chester Carlson was a patents attorney when he invented the xenographic photocopier, which was a response to the excessive time taken to hand copy documents that were needed for his work (Owen 2004).

In their bestselling 1999 book *Sparks of Genius: The Thirteen Thinking Tools of the World's Most Creative People*, Robert and Michele Root-Bernstein claim that trans-disciplinary lessons are important because they can "help everyone to think simultaneously as artist *and* scientist, musician *and* mathematician, dancer *and* engineer. An education that trains

[2] For a pictorial explanation of Rubin's Vase, see: Donaldson, J. 2017. Rubin's Vase. In *The Illusions Index*, ed. F. Macpherson. Retrieved from https://www.illusionsindex.org/i/rubin-s-vase (accessed: 30 October 2022).

the mind to imagine creatively in one field prepares the mind for creative application in any other" (Root-Bernstein and Root-Bernstein 1999). Nancy Andreasen, in her 2006 study of the neuroscience of creativity, claims that "one of the best ways to get a new perspective on things – an important resource for thinking creatively – is to tackle a new field that you know little or nothing about" (2006: 161). As Andreasen explains:

> Mother Nature does not give everyone the gift of being a polymath (a person who knows many things and who has mastered many fields). But that can be at least partially achieved by nurture. The first step is to learn a new and totally different field. Many people have a secret longing to do something different from the work that is their daily bread. If you have always wanted to try your hand a painting, to take up the violin, or to master a foreign language, take the time and make the effort to do it. Very importantly, don't dabble. Do it in depth and with a passion, for this is the only way that you will really exercise your brain. Many successful people have benefited from working in one field by day and in another in their spare time. Churchill and Eisenhower painted. William Carlos Williams, a doctor, wrote poetry, as did Wallace Stevens, a lawyer. Einstein played the violin. Benjamin Franklin was an inventor, a writer, and a statesman. (Andreasen 2006: 162–163)

When presented with a problem, the problem solver can use their knowledge, past experiences and problem-solving techniques to solve, or attempt to solve, that problem. These attributes can be thought of as being part of the problem solver's toolbox. In general, one's ability to solve a problem will depend on the number of tools and on the range of different tools in their toolbox. No one heuristic works for all problems. Rather, it is important that many heuristics are available to try on any given problem. Creative thinkers will have several heuristics in their thinking toolkits. Different creative thinkers will have different heuristics in their toolkits, but the range of heuristics will be limited by preferences and recent experiences, not unlike the use of lateral thinking via a combination of convergent and divergent thinking, highlighted earlier in the chapter. In addition, bringing people together who have different perspectives and different tools at their disposal is likely to positively impact the search for the best solution.

Asking Questions

Asking questions is a learning tool that humans use from childhood; it helps us to generate and evaluate ideas as well as develop our knowledge. However, asking the right questions is not always easy because humans tend to apply filters that limit what is considered relevant. Determining which questions need answers is crucial to the process of problem-solving. Back in 1953, Alex Osborn introduced dozens of questions, including the six most famous questions: who, what, where, when, why and how (Osborn 1953). Originally, these six questions were explored in Rudyard Kipling's famous poem, in the story "The Elephant's Child" (1912):

> I KEEP six honest serving-men
> (They taught me all I knew);
> Their names are What and Why and When
> And How and Where and Who.
> I send them over land and sea,
> I send them east and west;
> But after they have worked for me,
> *I* give them all a rest.

These six questions remain as relevant in our contemporary era as they have been in times past, simply because there will always be problems that require solutions. Charles Thompson (1992) expands on this rationale by demonstrating how we can clarify a simple problem by asking 'why', and then asking 'why' four more times, making it five times in total to get to the bottom of a problem. His argument quite simply is that by the fifth time we ask 'why', the problem becomes better defined and we may either find answers or begin to seek resolution to the original question. The following table gives an illustration of how this might work:

Problem: the machine isn't working	
Ask Why 5 times	Answers
Why has the machine stopped?	A fuse blew due to an overload
Why was there an overload?	There wasn't enough lubrication for the bearings
Why wasn't there enough lubrication?	The pump wasn't pumping enough

(continued)

(continued)

Why wasn't lubricant being pumped?	The pump shaft was vibrating as a result of abrasion
Why was there abrasion?	*There was no filter*
Solution: Install a filter	

Analogy

> All perception of truth is the detection of an analogy. (Henry Thoreau 1851)[3]

Analogies are an important aspect of the way that humans think. From about the age of three, we can perceive similarities between current and past situations. We rely heavily on the ability to draw abstract parallels when we are confronted with new, complex or poorly defined situations or information. The ability to transfer what we know about one thing from one context to another, especially where one is well understood and the other is not, helps us to understand the other in terms of the better-known context. As our store of knowledge and experience broadens and deepens, it becomes easier to draw an analogy that encourages others to make connections between a shared attribute that may not otherwise have occurred to them. Therefore, analogies are useful for developing new ways of solving problems because they present unexpected connections that may encourage us to rethink an idea or issue.

Types of Analogy

We use analogies in everyday life. For example, to estimate the price of a house we would like to buy, we might compare it to a recently sold house of a similar size and age in that location. We will then infer from their similarities that the prices will be similar. If we have a problem communicating with a colleague, we could draw a parallel for communicating with other people, such as children, or look elsewhere for parallels, such as international, interpersonal or digital communication.

[3] LIBQUOTES. 2022. *Henry David Thoreau Quote*. https://libquotes.com/henry-david-thoreau/quote/lbc3g1y.

Analogies are widely used in all academic disciplines. Because the ability to form and understand an analogy involves higher order thinking, they are regularly used in exams and job interviews to test cognitive functioning. The ability to spot similar problems and apply a solution that solves one problem to another problem is crucial to mathematics and science. For example, Ernest Rutherford based the model of an atom on the solar system, while Antoine Lavoisier drew on the ability of our lungs to transform air to develop his theory of combustion. Designers and engineers also draw on the natural world to create objects that have a biological analogue, such as the widely-used and recognised anglepoise, or balanced-arm, desk lamp. Bionics is a field that uses biological and botanical analogies to systematically solve engineering problems, while law and literature use analogies to make comparisons, create deeper significance in their works and help readers visualise characters and places. Barker (2016: 222) demonstrates how analogies play an important role in law. For example, the effect that executive and legislative acts were having on extinguishing native title rights was analogised as a 'bundle of rights' and in the landmark Akiba V Commonwealth case of 2010, the trial Judge used an analogy with a 'quilt of united parts' to re-interpret the concept of society, making it possible for smaller regional claimants to come together to make a claim (Barker 2016: 229).

Several literary devices are also types of analogy: simile, metaphor, allegory, parable and exemplification. Similes are used to compare two things with connecting words like or as, but they rely on our understanding of their similarities. Some commonly used examples are "as hot as hades", "as quiet as a mouse" and "as straight as an arrow". Metaphors are useful for comparing two things by asserting that one is the other. Examples include "Time is money", "He was a blind fool" and "She cut him down to size". Allegories are stories where the characters and events have symbolic significance that illustrates the moral truths of a situation. Parables are simple stories about people that provide a spiritual lesson or moral principle, for example, the many Parables of Jesus in the Bible's *New Testament*, Aesop's fables such as the *Tortoise and the Hare* or the *Boy Who Cried Wolf*, and the *Emperor's New Clothes* by Hans Christian Andersen.

How to Use an Analogy

There are many ways to apply an analogy. You may have been asked to improve the performance of a particular issue, product or service. To generate ideas you can compare the issue, product or service with the attributes of something else entirely. The following example lists the attributes of a recycling centre and transfers those to the issue of water wastage in the home:

1. Identify what you want to happen: I wish to minimise water wastage at home.
2. Generate a list that has some similarity: I will generate a list that draws on the attributes of a recycling centre.
3. List active and passive attributes of the 'recycling centre': how it works, what it does, how it is used and what effects it has, its size and materials.
4. Transfer the attributes and apply to your issue, product or service: there are attributes applicable that help me look at water wastage in new ways.

Recycling centre	*Water wastage in the home*
Sorts and separates	Install a metre to identify who and how water is used
Recycles	Run a grey water pipe from the laundry to the garden
Crushes	Use an egg-timer to reduce the time spent in the shower
Reuses all materials	Get everyone in the house to see how they can minimise their use

Human thinking relies heavily on our ability to perceive similarities between one situation and another, or between current and past situations that are stored in our memory. The point is that a solution for one problem may be suitable for other problems. Even the experiences from childhood can be used to solve an adult problem. Page gives this example of what he calls 'cognitive diversity':

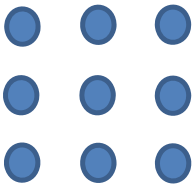
> Tom Plaskett, once the head of marketing for American Airlines, applied an idea he learned as a child in Raytown, Missouri: people like getting something for nothing. His mother was an avid collector of S & H Green

> Stamps. She traded her stamps for gifts. Plaskett took the Green Stamp idea and applied it to airlines. The result: frequent flyer programs. (Page 2007: 310–311)

Diversity of experience, across time and disciplines, plus an awareness of underlying similarities between two seemingly disparate problems, accelerates this facility. For example, *annealing* is a cooling process that is used to toughen glass and metals. Under ideal annealing conditions, all atoms would end up in their lowest energy (optimum) positions. This physical process is mimicked in a mathematical algorithm called *simulated annealing*. Most solution processes will only move in directions that lead to better local solutions. But simulated annealing can jump to solutions further from the current search area. The rationale for accepting a worse solution is that it may lead to a much better solution that is well away from the current search area, or 'outside the box'.

Assumption Surfacing and Provocation

The aim of some prompts for creative thinking is to clarify the underlying assumptions that accompany our values, beliefs, attitudes, and behaviours, and prevent us seeing other alternatives or opportunities. Cast your eyes over the nine dots below. Try linking them using no more than three straight lines and make sure that you pass through all nine dots without lifting your pen.



If you have seen this before, you will have been primed to recall that there is a 'trick' to it. However, the only trick is to question the assumptions that drive your fruitless attempts. For example, did you assume that your straight lines are confined to an invisible box that contains the dots? Did you assume that the lines would need to pass straight

through the middle of the dots? These 'rules' were not stated anywhere. What happens as soon as you question your assumptions? Did you solve the problem quite easily? This example demonstrates how easy it is to make assumptions that constrain our ability to seek out alternatives.

One way to bust or smash our assumptions is to think about a choice that we have made and interrogate the assumptions that unwittingly guided us by providing counter-assumptions. For example, I decided to buy an expensive brand of shampoo. The assumptions that guided me were:

Assumptions	*Counter-assumptions*
I need shampoo	I don't need shampoo
I need to buy shampoo	I don't need to buy shampoo
I need to buy good quality shampoo	I don't need to buy good quality shampoo
Quality shampoo is expensive	Quality shampoo is not expensive
Expensive shampoo will give me soft, silky hair	Expensive shampoo will not give me soft, silky hair
Soft, silky hair is important	Soft, silky hair is not important

I had no shampoo left and assumed that I needed to buy an expensive brand of shampoo because I assumed that it is important to have soft, silky hair. As I asked 'why' questions I began to realise that I had accepted that the last assumption was entirely plausible because of what advertising has taught me: that soft silky hair is an important part of my identity and I need to rely on an expensive brand of a mass-produced cleaning product called shampoo. The process of interrogating my assumptions made me reflect on this regular, taken for granted activity. Did I need to buy that brand, or any brand of shampoo at all? This made me think about how recent the popular use of shampoo is, and how many people in the world have never used 'shampoo'. Then I compared using shampoo with using soap: if plenty of people do not use soap, would my head adapt the way our body's biome does when it is not being regularly stripped by soap?

De Bono's (1990) PO or Provocative Operations offer another structured way to stretch our thinking from the known into the unknown by reversing, exaggerating or distorting a situation or object. For example,

we are familiar with the phrases 'dishes don't wash themselves' and 'money doesn't grow on trees', but we could turn these into provocations: the dishes wash themselves, money grows on trees, to prompt us to think again.

Attribute Listing

Attribute listing is, as the name suggests, a straightforward method that involves listing and analysing the parts of something before recombining these in new ways (Crawford 1954). By identifying the attributes of a product, service, strategy or system, we can examine something at a micro-level. In doing so, we may identify attributes that may otherwise have been ignored. Once we have a list of attributes, we can then recombine those attributes randomly to generate a range of unlikely combinations. Such combinations may prompt more ideas that lead to practical solutions. The key idea here is to play with the attributes and their combinations to assist in seeing the product, service or object in new ways. With this method, it is less important that the ideas are feasible because they could be used to trigger other ideas or be stored for later use.

In 1933, Fritz Zwicky, the astrophysicist who is often referred to as 'the Father of Dark Matter', took attribute listing further by providing a more systematic process for examining a great number of possible combinations for developing new ideas, products and solutions (de Swart 2019). His morphological analysis can be employed for solving small, simple problems or situations as well as large, complex problems. The advantage of this over less structured approaches is that it can be run by a computer program to generate random combinations that may reveal what has been overlooked or is not evident (ibid.).

Attributes are the constituent parts, properties, design elements and qualities of the thing in question. For example, the attributes of a car could be material, shape, colour, weight and price, and for a film could be plot, sound, characters, *mise-en-scene* and so on. For example, imagine that you would like to create a better sun shelter. The first question would be—better in what way? To answer this, you would need to understand the assumptions that are underpinning this. It may be that we want a sunshade that is easier to fold up, lighter, easier to carry, smaller or offers more UV protection. To clarify what it is that we really want, it is a useful first step to list the attributes of a sun shelter. You may list material,

weight, UV rating, size, transport, style and colour as the key attributes, in which case you could create a table with these as column headings. See the Table below:

Table: Sun shade

material	*weight*	*UV rating*	*size*	*transport*	*style*	*colour*

This morphology provides a starting point. Once you begin, you will probably add more categories. If you are working in a group, you may add more categories, more quickly. Using a morphological box is a quick and methodical way to visually identify the attributes of the product or process that you want to work on. This makes it clear and easy to add as many variations as you can think of to these columns. Brainstorming can also be used during this process. When you are happy with the detail, you can then begin to make interesting combinations, or provoke new combinations by randomly combining alternatives or systematically selecting entries from each column. This is also a useful process for identifying a part of a complex whole that you can work on. For example, rising ocean levels is a global problem that affects coastlines and island communities. Many scientists are working to find solutions, but it is not possible for one scientist to solve such a huge global problem alone. Instead, they may investigate a part of the problem or work in teams to combine resources to examine the bigger picture.

Method: Define your problem in a short and clear statement.

1. List the attributes and values that can be varied or changed in some way by breaking it into its characteristics or sub-concepts. If you are working in a group, make these available to everyone.
2. Work on organising or grouping these to reduce them to a more manageable number for your context. When you are satisfied, label

the categories. Useful labels might include parameters such as function, material, construction, size, shape, etc.
3. Put the different dimensions or parameters of the problem into a multi-dimensional matrix arranged along axes.
4. Force connections by searching the matrix for useful combinations.
5. Eliminate undesirable and unworkable combinations and develop the short list (creating minds).

In the creative field, an analogy is a simple thinking technique that helps one gain fresh insights by finding unexpected similarities. Although largely used in literary discourse, analogy can also be expressed in scientific or mathematical terms: consider an object or system that has a set of attributes that we denote as $\mathbf{x}$. For example, the attributes of an object might be its colour and size, in which case the set $\mathbf{x}$ contains just colour and size, such that $\mathbf{x} = (\text{colour, size})$. Each attribute could take on a range of values. Assume that the performance of this object can be measured using a performance index P (also known as a Key Performance Indicator, or KPI). The purpose of innovation and creative design is to find the set of attribute values that give the maximum value for P. In general, many attributes could be involved in determining the value for P, which is one reason why the problem is complex. We can demonstrate most of the claims for diversity by using examples that either (i) have only a single attribute that can take on a continuous spread of values, or (ii) may have several attributes that take on only a small number of values.

Brainstorming

Brainstorming has become a generic term for creative thinking (even though they do not always refer to the same thing). Brainstorming was coined by a Madison Avenue advertising executive named Alex Osborn, who first wrote about it in his 1953 landmark book *Applied Imagination*. The 1950s saw enormous interest in creativity that resulted in a spate of literature about improving creative thinking skills, with Osborn's work possibly the most inspiring. Brainstorming emerged from this milieu as one of the first deliberate approaches to creative thinking and it is, as the name suggests, an activity designed to generate a flurry of ideas quickly. The fact that the term remains popular in the current milieu speaks to its effectiveness and continued applicability.

Not only does brainstorming allow the generation of ideas quickly, it is also an effective way to open possibilities and remove barriers, especially assumptions that confine or limit our thinking. One feature of brainstorming that has made it such an important tool in most organisations is that highly innovative ideas can emerge from the intersection of other seemingly unrelated ideas. Brainstorming creates an environment that is highly interconnected and subject to continuous, and sometimes dramatic, change. Such environments can be thought of as complex systems.

Having an idea involves an entire web of neural pathways that connect tens of millions of active neurons producing countless associations. In other words, for brainstorming to be effective, it is important to note that it involves two separate thinking phases: an idea generation phase and a refinement phase.

Brainstorming can be performed by groups or individuals, and you can combine both to good effect. However, individual brainstorming is useful for generating a list or solving a simple problem, whereas group brainstorming may be more useful for complex issues or problems. The advantage of working with others is that it increases the volume of ideas generated. Since these are more likely to spark further connections, there is a greater chance of generating a broader range of ideas that include quirky, unexpected and off-beat associations. To function as a really effective chain reactor of ideas, groups function most effectively when they are open and participatory. Groups comprised of members who share a common background or experiences are more likely to feel comfortable *enough* that each participant wishes to share. Diversity is also key to effective group decision-making. A group comprised of similar members is more likely to reduce the range of ideas generated and increase the likelihood that members will not offer ideas that challenge other group members. This is important because, like seeding a pearl, creativity can benefit from a little grit to prompt the process that creates the gem.

Group dynamics work best when members are open and willing to participate, when they listen to others and suspend judgement. Optimum groups need at least one person to take the intellectual risks, to throw out the outrageous, off the wall, crazy ideas that make us laugh out loud (lol). We need at least one person willing to add to the ideas, to say 'yes' and then take it further, which is a golden rule in improvisation. In 'improv', nobody slows the process down to ask a question or to criticise, however outrageous the scenario. Everyone, always, just says 'yes,

and…'. In just the same way, it can be pointless to doubt or take issue with ideas during a brainstorm. Sometimes really novel and useful ideas spring from going with the flow and having some fun because the more fun you have, the more dopamine is produced to help ideas flow, which in turn increases *fluency* and therefore the potential to increase *elaboration* and the production of *original* ideas.

In other words, we can improve the potential for a group to be effective by collaborating and including members from different age groups and stages in their career, who have different expertise, life experiences and lifestyles, as well as different genders and ethnicities. Research suggests that somewhere between five and seven people is optimum in a brainstorming group, because this offers a potential range of experience and points of view without being too unwieldy (Sawyer 2006). Brainstorming has become popular as an effective teambuilding exercise because it can be enjoyable for all participants.

The following offers some methodical guidelines to enact effective brainstorming sessions:

Who	Is the group diverse?
When	Is there sufficient time allocated? Is the time of day, week and year optimal?
Where	Is the environment comfortable in terms of light, heat and ambience?
How	How will ideas be generated and recorded? You might appoint a scribe or use a whiteboard or appoint someone not involved to keep everyone on track.
Why	Is the purpose clear?
What	What do members need to know or be supplied with?

Brainstorming should encourage these:

1. Quantity over quality
2. Taking intellectual risks and being outrageous
3. Keeping an open mind and deferring evaluation and judgement
4. Using creative thinking tools to help generate ideas
5. Combining ideas and spin-off ideas

If brainstorming helps us to generate original ideas by providing a method for improving the fluency, or quantity of ideas, and it encourages intellectual risk-taking and openness, the best way to put a dampener on the process is to stop ideas in their tracks and to discourage intellectual risk-taking by providing negative feedback and criticism. For example, you may be familiar with the following statements:

- That's crazy
- It's already been done
- If it was a good idea, it would already have been done
- It won't work
- It's too difficult
- It's too expensive

All of these statements may well be valid, but they hinder the idea generation stage. Even if they prove to be true, they are best left to the end of the process, when the ideas are measured against valid criteria; we must bear in mind that the core objective of both individual and collective or collaborative brainstorming is to prompt creativity.

Six Thinking Hats

One of the most well-known depictions of creative thinking is Edward de Bono's (1985b) *Six Thinking Hats*, which draws on the idea of deep thinking or contemplation. The eighteenth -century North American phrase, "to put on one's thinking cap", captures this idea with candour. De Bono's 'six thinking hats' demonstrate that we can use six different, but equally valid, ways of thinking depending on our purpose. The hat colours are blue, white, green, yellow, black and red.

- The blue hat represents the overview and meta-cognition: we use the blue hat to focus on the process of thinking rather than the content. Think of it as the role of the orchestra conductor who keeps the musicians in harmony and on song.
- The white hat represents information: we use the white hat to focus on information by gathering what is already known, identifying what is missing and determining what further research we need to understand the problem fully.

- The green hat represents creativity: we use the green hat when we want to focus on generating new possibilities by engaging in provocations and seeking alternatives or change.
- The yellow hat represents the logical positive: we use the yellow hat to focus on the positives by listing benefits, values, strengths and advantages.
- The black hat represents judgement and caution: we use the black hat to focus on why an idea may not be accurate, useful or suitable, by using logic and reason.
- The red hat represents emotion: we use the red hat to focus on how we feel about a problem by analysing the attitudes and feelings that underpin our responses.

Forced Connections

Unlike analogies, forced connections is a creative thinking tool that involves combining two things that have no natural relationship. There are several versions and variations of the forced connections tool. The simplest version is to join two words or phrases together to create something new. The rock bank The Rolling Stones did this when they were under time pressure to complete lyrics for what became their acclaimed 1972 album *Exile on Main Street*. Mick Jagger describes how they created song lyrics by writing phrases on slips of paper, which they arranged and rearranged until they were literally forced together (Stones in Exile 2010).

A slightly different version is to generate random lists to create an entirely new thing. For example:

Drink	Orange
Cloud	Tissue
Think	Friend
Cow	Day

Using these lists, you might create the following: drink orange; cloud tissue; think friend; cow day; drink tissue; think day; drink day; think orange; and so on. You may prefer to work with someone else to create separate lists that you combine and recombine until you find a promising combination, which you then refine to develop something entirely new. From this list, we might focus on the idea of "drink tissue" because it

sparks an idea about the properties of a tissue and how to make a tissue thirstier or more absorbent.

The forced connections tool is a type of applied attribute listing used to prompt new ideas and solutions to problems. Michael Michalko (2006) has a version that he refers to descriptively as *Brutethink*:

1. State your problem: *how to improve my time management.*
2. Randomly collect about six nouns to avoid compiling a list that has any relationship to your problem. List characteristics or associations for each word. It doesn't matter whether they are 'correct' or not. The point is to generate ideas. For example:

Yellow	*Sweet*	*Wood*	*Price*	*Corner*	*Health*
Happy	honey	tree	cheap	dunce	Sickness
Sunny	smile	timber	**expensive**	pointed	Wellness
Flowers	**tooth**	**table**	dollars	**deliberate**	Medicine
submarine	apple	brown	bargain	trapped	**Fresh air**

3. Forced connections between the characteristics of each random word and your problem. For example:
    - I could manage my time more efficiently if I changed my attitude to be happy about the situation and look for the positives rather than the negatives.
    - I could get my teeth stuck into my work more.
    - I could create a weekly timetable, or a timetable for that assignment so that I can get it done by the due date.
    - It is costing me money to hire taxis/babysitters/fast food and so on because I am not organised, so I could save a lot of money by managing my time more efficiently.
    - I could plan my time much more deliberately so that I have more time to do sport/spend time with my family/shop.
    - I could spend more time exercising so that I feel invigorated and ready to get through my day.

Another type of forced connection can be achieved by *forcing* an analogy. Comparing two things that have little or nothing in common forces us to view them from a different perspective and to make a connection that we would not otherwise have made.

You can also practice converting a problem into a paradox and then find a useful analogy. For example:

1. Problem statement: I want more money but prefer to travel than work in one place.
2. Analogy: I want light without using resources.
3. Solution: use a natural light source such as the sun.
4. Then apply this solution to my problem
5. Solution: make money by travelling as a writer or guide

Lateral Thinking

Lateral thinking is a method that has entered popular lingo as a way to think 'differently' from the norm. The term and concept of 'lateral thinking' was invented by Edward de Bono and was first presented in his book *The Use of Lateral Thinking* (1967), to help us do what computers are deemed not able to: creative and perceptual thinking. De Bono's research into complex, self-organising biological systems such as the glands, respiration, heart and circulation led to his interest in interactive systems, which he applied to neural networks in the brain (2016). Recognising that the brain is good at forming patterns, which are asymmetric, led him to the idea of lateral thinking. He argues, in his many books on the subject, that the lateral thinker understands that linear, step-by-step logical problem-solving does not always produce solutions, and that lateral thinking is akin to grasping a joke after hearing the punch line, which would usually come at the end (de Bono 1967, 1971, 1990, 2016).

Consider this example of lateral thinking:

> It is 1990: you are a video store owner who has a big problem. One in three returned videos has not been rewound, which is causing great customer dissatisfaction. You need a creative low-cost, sustainable solution. What do you do?

This example seeks to demonstrate that we need to define a problem clearly before we rush to find a solution. Usually, we try to solve a problem with what we already know, but it is only when this does not work that we are forced to think more laterally. If the parameters of the solution are that the solution must be low cost and be sustainable then most answers will not fit the criteria. The solution is in fact quite simple: put a sticker on the VHS to let borrowers know that they have to rewind before returning.

Lateral thinking is about moving sideways when working on a problem to try different perceptions, different concepts and different points of entry. It can be used as a specific set of systematic techniques to alter or generate new concepts and perceptions or it can be used more generally to explore a range of possibilities and approaches. The term covers a variety of methods, including provocations, to cut across our patterns of thought and has much to do with changing our perceptions. Sometimes we just need to stand back and look at the whole and focus on the parts, the gaps, challenge assumptions and seek alternatives.

Mindmapping

The term 'mindmapping' was popularised in the 1970s by British psychologist Tony Buzan (1974) in his original bestseller *Use Your Head*. It refers to a visually spatial process that has been used for thousands of years to externalise thinking. Drawing on images, symbols and single words, it had been used to map important conceptual understandings, from Porphyry of Tyros in the third century, to Leonardo da Vinci through to the present (Buzan 2002, 2005). The key difference between what we now refer to as mindmapping and concept mapping is that mindmaps focus on a single idea or issue, rather than several.

Neuroscience confirms that the brain, which works by making associations, has far more capacity for recognising and storing images than words. This explains why the eye is drawn to images more than words, why images trigger associations that are more evocative than words and why mindmapping helps us to record, connect and create new ideas (Wycoff 1991; Budd 2004; Zipp 2011). By using images, symbols and single words, we can organise ideas as a single, concise representation. Mindmaps help us to download the chaos in our head, in any order or as ideas come to mind. By externalising and visualising our thinking process in this way, we also begin to organise our thoughts and as we begin to

classify and categorise our mindmap around a central point; what emerges as a result is a radial mind map.

The 'radial mindmap' is a memorable text: at a glance it offers a holistic overview that allows us to see patterns and relations between the whole and the parts, and provides the freedom and flexibility for the addition or revision of ideas. Variations in the size, colour and width of connections also improve the visual and conceptual clarity of the image for storage and recall. Mindmapping therefore facilitates conceptual classification, organisation, recall and comprehension and it enhances higher order thinking skills by opening conceptual space and encouraging us to make complex associations that demonstrate meta-cognition and rich conceptual understanding (Budd, 2004; Anderson and Krathwohl, 2001).

Plus, Minus and Interesting (PMI)

PMI is an acronym that stands for Plus, Minus and Interesting. It was yet another creation of Edward de Bono that was presented in his book *De Bono's Thinking Course* (1985a, 2009). PMI offers a structured framework to focus on a situation, idea or object from more than one perspective. Like the Six Thinking Hats (de Bono 1985b), it encourages us to focus on just one aspect at a time. Limiting the parameters of what we are thinking about to systematically split our inquiry into separate activities increases the likelihood of generating more ideas. This approach helps to target our inquiry and idea generation. In other words, using this tool is a little like using a torch or laser beam to cut through the darkness. This is important when we are engaging in problem-solving because we need to be able to generate as many ideas as possible before we begin the process of refinement.

The idea with PMI is that individually, one person within a group, or all group members, focuses on listing every 'plus' attribute of one aspect of the object in question, before thinking about the 'minus' or other 'interesting' attributes. You may interpret a 'plus' in terms of strengths, advantages or favourable aspects. The point is not to be distracted into an argument or debate about whether it really is an advantage or not. This is irrelevant as this stage is like a brainstorming activity in which the focus needs to be on generating ideas without censure of any kind. Generating a 'minus' list would probably include a range of weaknesses, disadvantages or negative aspects. The 'interesting' list may be the most difficult because it stretches us to include what we consider whacky, odd or unusual. It can

also house any other aspects that do not appear to be either positive or negative. PMI is useful during the solution finding and evaluation phases of the creative problem-solving process. Not unlike listing pros and cons, PMI can be used to assess and reduce the number of solutions generated. But more than that, it can also produce new and innovative—and therefore 'interesting'—perspectives on solutions that may not have been previously considered.

Reversals

Successful and creative people know the importance of being able to see things from multiple directions: upside down, backwards or inside out. Charles Thompson makes the important point in his book *What a Great Idea: The Key steps Creative People Take* (1992), that "any attribute, concept or idea is meaningless without its opposite". The term 'Reversals' was popularised by Alex Osborn (1953), and was adapted by Steve Grossman who used the phrase 'Assumption Reversals' to refer to the same concept (see Van Gundy 1998). This was further extended by Michael Michalko in *Thinkertoys* (2006) where he uses the term 'False Faces'. Reversals are tools that help us clarify a problem by asking the opposite of what we want, so that we can 're-reverse' and improve it. It also helps to highlight our assumptions and encourages us to take alternative points of view.

For example, instead of thinking about 'how to improve my grades at school', we could ask: 'how can I diminish my grades'. Assuming that one needs to improve one's grades, simply saying that one will try harder may not be useful. But thinking about how one might reduce one's grades and re-reversing this to ask, 'so what could I do to not reduce my grades', would generate different options from thinking about 'how to improve them'. As Van Gundy (1998) has suggested, a more systematic way would involve the following simulated situation:

1. State the problem, then state it in reverse.
2. List your assumptions
3. Challenge your assumptions
4. Reverse each assumption

1. State the problem: *I need to achieve higher grades.*
   State the problem in reverse: *I need to achieve poor grades*

'Poor grades' is clearly a problem for any student. But this is not always as clear-cut as it appears. What assumptions underpin your understanding of the issue?

2. List your assumptions about why you have poor grades.
   List as many as you can to clarify the problem.

   - Lecturers
   - Curriculum
   - Effort
   - Family crises

3. Challenge your assumptions:

   - lecturers—is this about expertise, communication, personality and availability?
   - curriculum—is this about workload, timetabling, content, training and assessment?
   - effort—is this about time or attention?
   - family crises—is this about one-off events or ongoing issues?

4. Reverse each assumption: do the poor grades indicate any particular areas of weakness? If the poor grades are due to poor marks for participation and the non-submission of at least one assignment, this would indicate that the focus for improving grades needs to be discovering why you were not attending class and submitting all assignments, so that you can reverse this.

SCAMPER

Created by Bob Eberle (1971, 1987), SCAMPER is a memorable acronym that stands for substitute, combine, adapt, modify/magnify/minify, put to other uses, eliminate, reverse/rearrange. The general principle here is to take well-known formulas that have 'stood the test of time' and mix them up (ibid.). The mixing would often either prompt something new or create a new variation, or perhaps a rendition, of something that has pre-existed.

Perhaps the easiest way to explain this is to consider popular movies over the past few decades. Many films owe their plots to parables, fairytales or mythology. The Disney-animated films include: *Tangled* (2010), which is based on the Brothers Grimm fairytale *Rapunzel*, and *Frozen* (2013), which is based on Hans Christian Andersen's *The Snow Queen*. There are also many versions (in brackets) of the following: *The Beauty and the Beast* (14), *Cinderella* (37), *Little Red Riding Hood* (32), *Jack and the Beanstalk* (16), *The Little Mermaid* (6) and so on. Among the fairytales in disguise are *Pretty Woman* (Cinderella), *Hunger Games* (Jack and the Beanstalk), *Dirty Dancing* (The Little Mermaid), *Edward Scissor Hands* (Beauty and the Beast), *Pan's Labyrinth* (The Little Match Girl), *AI Artificial Intelligence* (Pinocchio) and *Terminator 2* (Rumpelstiltskin).

The 'variations of a theme' idea that underpins SCAMPER also partly underpins the success of genre entertainment. Arguably, the advent of the Internet from the 1990s has turned SCAMPER into an everyday practice, even if the acronym is not referred to or acknowledged. 'Mashup', defined most broadly as "a mixture of different, often contrasting, elements" (Collins Dictionary, 2022) has become commonplace in digital culture. Most Internet and smartphone users—especially those who are active social media participants—are also digital 'Prod-users', where the user is concomitantly a consumer (user) and producer (creator) of content. In this context, SCAMPER offers a quick way to generate new ideas by taking existing ideas or attributes and modifying them in some way(s).

Conclusion

The chapter has sought to identify some of the assumptions that stymy our thinking and introduce ways we can play with ideas or thoughts—not just on a 'creative day', but on an everyday basis. The important thing to keep in mind is that there are many prompts and tools for creative thinking and idea generation.

As expressed at the start of the chapter, it is not feasible to explore every single possibility or every piece of writing about creativity. What we have done in this chapter is to introduce some of the main ones. As some astute readers would have identified, many of the prompts we have highlighted are reasonably familiar because they have made their way into bestselling self-help, psychology, corporate management and leadership literature over the past fifty years or more. Indeed, some terminologies—such as De Bono's 'thinking hats' and 'lateral thinking'—have entered

into everyday-speak. Our intention in identifying and presenting them in this chapter is both to introduce them as 'prompts for creativity' (as per the title of the chapter) and to make sense of what messages they convey to us about the discourse of creativity. Suffice to say that some have stood the test of time, while others have been challenged by new orthodoxy.

We have opted not to inject substantive critique in this chapter as it is not our intention to endorse (or by the same token, dis-endorse) any prevailing concept or idea—doing so would run counter to the aims of this chapter, which is to highlight what we have identified in our research as the key 'prompts' for creativity. However, we would encourage readers to think critically about each 'prompt' that is featured in this chapter. After all, thinking critically is a necessary tool of everyday creativity.

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CHAPTER 5

Creative Problem-Solving

Abstract This chapter presents Alex Osborn's 1953 creative problem-solving (CPS) model as a three-procedure approach that can be deployed to problems that emerge in our everyday lives. The three procedures are fact-finding, idea-finding and solution-finding, with each step carefully informed by both divergent and convergent thinking. Using case studies to elaborate on the efficacy of CPS, the chapter also identifies a few common flaws that can impact on creativity and innovation. This chapter explores the challenges posed by 'wicked problems' that are particularly challenging in that they are ill-defined, unique, contradictory, multi-causal and recurring; it considers the practical importance of building team environments, of embracing diversity and difference, and other characteristics of effective teams. The chapter builds conceptually and practically on the earlier chapters, especially Chapter 4, and provides case studies to help make sense of the key principles of creative problem-solving.

Keywords Creative problem-solving · Fact-finding · Idea-finding · Solution-finding · Divergent thinking · Convergent thinking · Wicked problems · Groupthink

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Introduction

> The faster things change … the stronger your creative thinking and problem-solving skills need to be. To successfully compete in the twenty-first century, leaders are calling for increased training in creative problem solving everywhere from boardrooms to elementary classrooms. (Grivas and Puccio 2012: 21)

> Historically, pandemics have forced humans to break with the past and imagine their world anew. This one is no different. It is a portal, a gateway between one world and the next. (Roy 2020)

As human beings, we encounter situations that present problems every day. Some are quite easy to solve because there is an established solution or procedure for arriving at a correct solution. Pilots, doctors, engineers and mechanics routinely use set procedures to anticipate and manage problems as they arise. This approach to problem-solving is referred to as an algorithm. We are familiar with algorithms from our search engines such as Google, our Facebook accounts and from other online sites. They predict our interests and register information based on previous activity, and they are now somewhat synonymous with contemporary technology terms like 'machine learning' and 'artificial intelligence'. Developed through creative and innovative thinking, algorithms are useful and efficient because they save time and reduce the need for duplication. Indeed, algorithms are now seen as critically important to our fast-changing world that relies on digital innovation.

In much the same way, creative thinking and problem-solving skills are deemed paramount in a world characterised by unparalleled "accelerated change" (Grivas and Puccio 2012: 21). Today, we encounter an expanding range of 'wicked' problems, such as climate change, global poverty, pollution, cyber-security and pandemics (such as COVID-19). In this context, the effective management of change is a process of constant readjustment, highlighting the need for flexibility and well-honed collaborative problem-solving skills.

Creative thinking, and its application in problem-solving, is a life skill required for the successful navigation of challenges and opportunities. For Grivas and Puccio (2012), life's challenges are eased through the application of creative thinking. Creative thinking is universal and applicable to

everyday situations. It is characterised by a series of steps, including clarification, idea generation, solution development and the implementation of plans. Although humans are not uniformly creative, each of us can refine and develop our creative capacities (Grivas and Puccio 2012: 23–24). Striking a balance between immersion and detachment is an important part of the creative problem-solving process. Creative problem-solving highlights paradoxes and complexities, which compel problem solvers to be both fully engaged with a problem and also distant enough from it to be open to new ideas (Proctor 2014: 130).

COVID-19 has foregrounded intersecting problems and the importance of collaborative approaches to problem-solving. The pandemic could be a "rupture" that accentuates values of humanity, sustainability, equity, justice and care (Holmes 2021: 84). Author Arundhati Roy describes the pandemic as a "portal" capable of releasing us from unproductive thinking: "We can choose to walk through it, dragging the carcasses of our prejudice and hatred, our avarice, our data banks and dead ideas … Or we can walk through lightly, with little luggage, ready to imagine another world" (Roy 2020). Imagining a better world is an important point of departure, yet negotiating the conditions of this world, and bringing it to fruition, will be a challenge. Samuel Alexander, an academic and Research Fellow with the Melbourne Sustainable Society Institute, reminds us that the future is likely to involve disaster *and* design (Alexander, in Cunningham 2021: 125–126). Our primary aim should be "to constitute the future through planning and community action" rather than to "have the future constitute us" (Alexander in Cunningham 2021: 126). Envisaging the world anew will require well-honed critical and creative problem-solving strategies.

Problems vary in severity and scale. Perhaps your partner has informed you that he/she is leaving, or an experiment you have conducted has failed. Creative thinking is required in these instances and although there may not be an obvious procedure to follow, situations of this kind can be approached systematically. An algorithm provides instructions to a proven outcome whereas a heuristic approach to problem-solving is less predictable because it shows you *how* to look for the solution, rather than what it is. One of the most widely used and researched heuristic approaches to finding acceptable solutions for complex and wicked problems is what we refer to in this chapter as the creative problem-solving process (CPS for short). This chapter will outline the creative problem-solving process and explore the challenges posed by

wicked problems, before touching on the practical importance of building team environments, and the characteristics of effective teams.

The Creative Problem-Solving Process

The creative problem-solving process[1] is a systematic approach to problem-solving that was first proposed by Alex Osborn in 1953 in his landmark book *Applied Imagination*. The approach went through several refinements over a period of five years. Osborn began with a seven-step model that reflected the creative process (orientation, preparation, analysis, hypothesis, incubation, synthesis and verification), and by the edition of his book in 1957, it comprised the three procedures that are still widely used today: *Fact* finding, *Idea* finding and *Solution* finding (Osborn 1953, 1957). Osborn founded the Creative Education Foundation at the State University College at Buffalo, New York, in 1955 and collaborated closely with Sidney Parnes to create the 3-stage, 6-step Osborn-Parnes CPS.[2] It has been adopted by many creativity researchers since, to the extent that the CPS is practised in multiple forms, typically in five-, six- or seven-step processes. Whether the CPS is presented as a five-, six- or seven-step process, Osborn's three broad "finding" procedures remain. With this principle in mind, the next sections of this chapter present these three procedures in practical terms, helping us make sense of what CPS is about, and how it can enhance both creativity and innovation in practice. CPS is ultimately a procedural framework that helps the problem solver to organise and improve his/her thinking by breaking the process into clearly defined manageable tasks. It is not prescriptive, and it is anticipated that problem solvers may skip back and forth between phases as required.

[1] The creative problem-solving process explored in this chapter is not to be confused with the broader 'creative process' that is presented in Chapter 2 of this book. See Chapter 2 to understand what creative process entails.

[2] A general online search of the Osborn-Parnes Creative Problem-Solving (CPS) process will generate many results. One of them is: https://projectbliss.net/osborn-parnes-creative-problem-solving-process/. Osborn is largely credited as the creator of CPS, hence references are largely made to him (Osborn 1953, 1957).

Procedure	*Phases*	
1. Fact-finding	Objective-finding (…to look for a problem)	Divergent thinking Convergent thinking
	Research the problem	Divergent thinking Convergent thinking
	Define the problem	Divergent thinking Convergent thinking
2. Idea-finding	Generate ideas	Divergent thinking Convergent thinking
	Select and strengthen	Divergent thinking Convergent thinking
3. Solution-finding	Test solutions	Divergent thinking Convergent thinking
	Create plan for action	Divergent thinking Convergent thinking

Each procedure (and the steps within it) proceeds from a broader exploratory production phase to a more concrete judgement phase and encompasses divergent and convergent thinking. In other words, the CPS involves two types of complementary relationship, and the ability to move between phases and types of thinking. This is supported by research in neurophysiology and cognitive psychology, which shows that problem-solving and decision-making involve these complementary phases of thinking (Ruggiero 2009: 7). We also know this from our everyday experience, when we gather lists of music, or information about travel destinations or restaurants that we then refine to make decisions. The difference is that we tend to mix the production and judgement phases so that we may begin to evaluate and judge in the midst of generating possibilities. What the CPS offers is a way to harness these natural thought processes so that we can take full advantage of them. To cite an example from a recent context, the COVID-19 pandemic has given rise to creative solutions across multiple domains. Although divergent thinking has taken precedence, Kapoor and Kaufman (2020: 5) suggest that convergent thinking will be needed to evaluate solutions to problems encountered during, or as a consequence of, the pandemic.

To explain how to use divergent and convergent thinking skills for creative problem-solving, we draw an analogy with driving (Puccio et al. 2012). Divergent thinking is what we engage when we want to generate ideas; we only put the brakes on with convergent thinking when we are ready to evaluate what we have produced. The distinction between these

two processes is important. Applying the brakes while we are trying to think creatively is just as obstructive to creativity as 'kangaroo-hopping' is for driving. Puccio et al. (2012, 48) provide an interesting example that demonstrates how digital photography has changed more than just the way we take photographs. Previously, the number of photos we could shoot on film was limited by the size of a roll and the cost of film and processing, which meant that we tried to minimise risk. The innovation of digital photography allows us to experiment because we can take as many as we desire, and choose the image we want. We do not need to be constantly moving between divergent and convergent thinking. We can literally defer any judgements until later when we can download, organise, edit and delete. This demonstrates that to apply thinking to advantage, we need to be clear about the types of thinking we are using when solving problems creatively. Drawing from Puccio et al. (2012: 51 and 57), we can summarise key pointers, as guiding principles, for convergent and divergent thinking as follows:

Convergent thinking:	*Divergent thinking:*
Be constructive to build and strengthen	Defer judgement
Don't retreat to comfort, safety and convention	Seek quantity
Stay focused—keep evaluating to improve	Make connections
Check and test options against objectives	Seek novelty

Having clarified the various terms, the chapter takes on a 'practical' turn by looking at the three CPS procedures. It is worth pointing out here that these three CPS procedures also utilise many of the prompts for creativity that were unpacked in the previous chapter (Chapter 4), so a cross-referencing approach to reading the rest of this chapter is highly recommended.

Procedure One: Fact-Finding

One of the most important aims of this initial procedure is to find the right questions because many problems are symptoms of larger problems. If these can be identified and addressed, the solutions that have greater impact can be found. This very first procedure has two key phases: researching the problem and defining the problem.

It is worth highlighting that there is, possibly, an initial phase preceding the two key phases, which is about identifying a problem. Essentially, if you do not have a problem, *Objective Finding* will need to be included to help identify one—if indeed, one exists. If you have a problem, which is more than likely, proceed to the next phase.

The use of *divergent thinking* can help to generate a possible problem, or indeed, to frame the problem to aid in finding a solution. The following questions may be useful in helping to focus on a particular area:

- what would you like to happen?
- what are your goals?
- what would you like to accomplish?
- what would you like to do?
- what would you like to do differently?
- what would you like to improve?
- what is wasted?
- what barriers exist?
- what upsets you?
- what do you complain about?

Use *convergent thinking* to reduce the number by asking:

- 'what will I gain if' or in applying 'reversals', such as: 'what will I lose if'.
- what are the positives?
- what is the opportunity?

Research the Problem: In the exploratory procedure of *fact finding*, it is important to gather as much relevant information about your problem as possible. This includes everything related to the situation, such as any assumptions, hunches and perceptions that one might have. This is where the application of *divergent thinking* is particularly critical, as one identifies and gathers relevant information to have a better and more complete understanding of the problem. *Asking questions* is the key to determining what we need, so using the famous—and by-now commonplace—'5Ws and H' six questions would be the best way to start: who, what, when,

where, why and how (Osborn 1953). In practical terms, the questions could be framed in these ways, among many other possibilities:

- who is or should be involved?
- what is or is not happening?
- when does this or should this happen?
- where does or doesn't this occur?
- why does it or doesn't it happen?
- how does it or doesn't it occur?

Then the following questions may guide you further:

- what information do I have?
- what do I need?
- what is missing?
- where do I find the missing information?

To avoid a thinking flaw known as *confirmation bias*, we do not have a solution in mind during this phase. Otherwise, you will tend to only keep information that supports your prior point of view, while information that might lead to alternative (and potentially better) solutions is ignored. It might also mean that information that would have invalidated the currently held assumptions is missed. Edward de Bono's (1985) 'White Hat' reminds us to focus on information by gathering what is already known, identifying what is missing and detemining what further information we need. Applying the 'White hat' can help us to stay focused.

Use *convergent thinking* to review all the information that you have gathered. You might use a *mindmap* to summarise, make connections and categorise what you have discovered (Buzan 1974). Select the most important facts, hunches, perceptions and assumptions, and deploy the 'Blue Hat', which represents generating an overview, to assess and monitor your progress (de Bono 1985).

Define the problem: This is a refinement phase to accurately clarify and define the problem. It is important here to explore the challenges and opportunities to make sure that you are focusing on the right problem, so that you do not waste time being side-tracked or solving the wrong problem.

As mentioned earlier, a person attempting to either research or define the problem should use *divergent thinking* to generate a range of possible problem statements by *asking questions* such as the 5Ws and H (who, what, where, when, why and how):

- what is/isn't happening, when, why, how does/doesn't it happen, who is/should be involved, are there other problems caused by this, or:
- what do I want to achieve?
- what are the key objectives?
- what are the constraints (physical, cultural and legal restrictions)?
- who will benefit: clients, users, communities, privileged or deprived groups?
- who may suffer the consequences? Are they individuals, local or global communities, and will present or future generations be affected?
- (It is worth highlighting here that this question is also one of ethical consideration, which is of paramount importance in problem-solving.)

At this juncture, it is recommended that alternative definitions be listed: "In what ways might I….?" (or IWWMI for short). Clarify fuzzy statements by using the 5Ws and H again. You may then use creative prompts—such as *Reversals, Assumption busting*, *Brainstorming* and/or create a *Mindmap*—to find more ideas, make connections and organise them. Each of these prompts should contain just one problem to address them accurately and systematically.

When you have a range of problem statements that you are happy with, *convergent thinking* can be applied. Use de Bono's (1985) 'Black Hat', which represents judgement and caution, to pinpoint your motivation and ability to achieve realistic goals by asking questions about outcomes or obstacles. These include questions about whether proposed ideas or solutions are broad enough, open-ended or who owns a problem and can take responsibility for it, or if one is motivated enough to invest time and energy into the problem (Puccio et al. 2012).

You may then use deBono's 'Red Hat' (1985) to help clarify your motivation, and, indeed, identify your emotion and attitude towards wanting to resolve a problem. This would involve questions such as:

- how important is this to me?
- why is this important to me now?
- how does this situation make me feel?
- what attitudes, beliefs and values inform my position? (again, this question is laden with ethical thoughts and considerations)

The most promising statement is then selected for Procedure Two.

Procedure Two: Idea-Finding

Generating Ideas: To have the best chance of finding the best solution, within the context of the problem, we need to generate as many ideas as possible that may form a part or whole of a solution. This is where ideas are produced, risks taken, connections or new combinations made—and where enjoyment is derived. For each of the problem definitions, wild, truly outrageous ideas are proposed without any criticism or evaluation for each of the problem definitions. To achieve this, the problem statement needs to be displayed where it can be seen.

U*se divergent thinking* to generate ideas. Set a goal of around 20 or even 50 ideas. This includes whacky, off-the-wall ideas because they may provoke, intersect or combine with other ideas to create a better solution than any of these alone. Knowing how to generate ideas quickly is therefore an important aspect of the CPS. This can be achieved by mobilising some or all of the creative prompts (introduced in Chapter 4), including:

1. asking questions
2. using analogies
3. assumption surfacing and provocations
4. attribute listing
5. brainstorming
6. six thinking hats
7. forced connections
8. lateral thinking
9. mindmapping
10. PMI (plus, minus and interesting)
11. reversals
12. SCAMPER (substitute, combine, adapt, modify/magnify/minify, put to other uses, eliminate, reverse/rearrange)

These creative prompts often function as techniques that can help us in one of three ways:

1. The first group of creative prompts rely on analysis, or our ability to break information apart, in the service of the supporting the second group. This includes techniques such as *Asking Questions, Attribute Listing, PMI, 6 Thinking Hats, Mind-mapping, Assumption Surfacing and Provocations, Reversals and Brainstorming*.
2. The second group relies on our ability to synthesise or combine elements into new wholes. This includes *Analogies, Forced Connections, Mind-mapping and SCAMPER*.
3. The third group of techniques rely on our ability to generate ideas by challenging our assumptions and changing our perspective. This includes *Lateral Thinking and Provocations*.

Use *convergent thinking* to select around five ideas that best meet your criteria for a solution. Keep all ideas in case you wish to refer to them later.

Formulating solutions: Use *divergent thinking* to take the best ideas and formulate solutions. This involves strengthening the positives of these ideas and then testing them against key criteria. *Asking questions* such as 'will it…' can help you generate a list of criteria for the perfect solution that may include questions about safety, sustainability, guaranteed supply of parts and in-house ability to manufacture and distribute the product. It is recommended that you aim for about a dozen criteria, as you will be able to rank their importance for your problem. Eventually, these will be used to evaluate your solution in the final stage. Some criteria might include:

- will it work?
- is it legal?
- is it acceptable to me/others?
- is it safe?
- are the materials and technology available?
- are the costs acceptable?
- will the public accept it?

- will higher-level administrators accept it?

Use *convergent thinking* to refine your criteria by half. You could evaluate ideas using a matrix that includes the criteria you have created, on one axis, and the ideas to see which ideas meet which criteria. We might prefer to have the best possible (optimal) solution, but it is good to recognise that most solutions involve some compromises. When you have chosen a final solution, use the 'Blue Hat' to assess whether the solutions are adequate, or implementable (de Bono 1985). Use *PMI* as a convergent thinking tool to evaluate according to your criteria. You may wish to improve or strengthen some of the positives, in which case use the criteria to help you strengthen them before converging again until you arrive at a preferred solution. Finally, assess whether the solution "feels" right, and whether you are comfortable with it. For example, you might ask in a personal way: would I allow this solution in my home? If it was my problem, would I be happy with this solution?

By the time you get to this stage, you are ready to create a *solution statement*. Describe your solution in detail and get ready for a plan of *Solution Finding* action, which is the next procedure.

Procedure 3: Solution-Finding

The purpose of this final step is to create a plan for action. This involves identifying what assistance and resistance will need to be accounted for before you create a plan for implementation.

Evaluate and Test: Use *divergent thinking* to create a list of all forms of assistance available (individuals, organisations, governments or any other resources) and a list for all forms of potential resistance (individuals, organisations, finance, regulations and legislation). *Asking questions* such as the following may help you:

- who might accept?
- who might resist?
- what do I need/what could hinder implementation – people, attitudes, resources, policies, and/or regulations?

Use *convergent thinking* to clarify the key parameters for assistance and resistance. This may involve some modification to your solution statement. Rank each list in order of importance and then generate ideas about how to use these to your advantage or to minimise them. Select a few ideas for use in your action plan. Use *PMI* as a convergent thinking tool to evaluate according to your criteria.

Create a Plan: This very final phase in CPS is about how one might implement the solution. It involves risk assessment, stakeholder approval, funding, production and distribution—and also an awareness of ethical concerns and constraints. To create a plan for action you will need to identify what needs to be done, by whom, when and what resources are required.

Use *divergent thinking* to generate all the possible action steps that you identified in your solution statement. This may involve asking questions such as:

- risk assessment: what is the probability that the solution will fail? What are the consequences if the solution fails? Is there a Plan B?
- will there be support for the solution from stakeholders? Will there be resistance from special interest groups?
- how will the solution be sold and promoted to key stakeholders?
- approval and possible funding for further development.
- how to implement—what needs to be done, and by whom?
- if the solution is a physical object, how will the object be manufactured and distributed?

Use *convergent thinking* to refine and organise these action steps into a workable plan. Then create a chart that includes the following key points, and may look like this:

	Task	*When*	*Who*	*Report complaints to?*
Immediate				
Short term				
Intermediate				
Long term				

At any point in time, it may be necessary to return to earlier steps if new information invalidates original assumptions.

Creative Problem-Solving Case Studies

Having explained the creative problem-solving (CPS) procedures and their phases above, this section exemplifies how these may work—or otherwise, when wrongly or badly carried out—in real-life practice and situations by examining brief case studies.

Case Study #1: Commercial Loyalty Program

The first case study is one pertaining to the deployment of a loyalty program that innovator and author Mark Payne writes about in his 2014 book *How to Kill a Unicorn: How the World's Hottest Innovation Factory Builds Bold Ideas that make it to Market*. Fahrenheit 212, a consultancy firm that Payne founded, was asked to improve the loyalty program for a world-class hotel chain.[3] His team began by clarifying the issue, where he discovered that the hotel's loyalty programs targeted the top 2% of clients, which yielded 20% of the company's profit. Fahrenheit 212 discovered that there was a high turnover of high-end clients who were not staying with the loyalty program despite the perks offered. There were, in short, decreasing returns. When the consultants dug deeper, they discovered an underlying problem with the concept of loyalty itself, which was the difference between the concepts of commercial loyalty versus human loyalty. There was dissatisfaction bordering on contempt, for these programs, as they were perceived as mutual exploitation. The following table captures the core points of difference between human loyalty and commercial loyalty:

Human loyalty	*Commercial loyalty*
Unconditional	Conditional
Remember past experiences	Reward future opportunity only
Move forward	Restart each year

(continued)

[3] Founded in 2002, Fahrenheit 212 described itself as "a global innovation consultancy delivering sustainable, profitable growth for companies by pairing business acumen and consumer empathy." It merged with Capgemini Consulting in 2016 and remains based in New York City, USA. (https://www.capgemini.com/in-en/news/press-releases/capgemini-acquires-innovation-and-design-consultancy-fahrenheit-212-to-drive/).

(continued)

Human loyalty	*Commercial loyalty*
Two-way give and take	Give only after receiving
Long lifetimes	12-month periods

Since the systems punished infrequency, rather than loyalty, these observations led Fahrenheit 212 to re-frame their key question into: *How can our loyalty program work and feel more like human loyalty*? (Payne 2014). Fahrenheit's proposed solution was to align commercial loyalty with human loyalty by carrying customers' privileges forward. Payne reported that this resulted in perceptible improvements to the hotel loyalty program (ibid.).

Case Study #2: PlayPumps

A second case study is one premised on a solution that did not adhere to creative problem-solving rules and practices. The problem, which remains a fairly common one, was that many villages in under-developed countries still rely on the villagers to pump water from underground reservoirs manually, or to cart water over long distances from remote sources to their homes. The creation of PlayPumps, or water pumps that are powered by children while they utilise play equipment, was deemed a solution to enable underground water to be pumped and stored in water tanks so that they can be readily accessed (May 2009: 172–175). As Daniel Stellar, from Columbia University's Climate School, explains:

> The idea behind PlayPump is simple, and it's not hard to see why so many people got excited about it. A merry-go-round type device is installed and connected to a water pump. As children play on the merry-go-round, water is pumped into a storage tank, and is then available on demand. (2010)

The idea seemed so elegant that it quickly caught international attention, and by 2008, millions of dollars had been pledged by agencies, businesses and NGOs for 4000 pumps in 10 countries. Yet, by 2010, the pumps had been abandoned and the industry dissolved (Stellar 2010). There were many reasons given for its failure, and these included technical and engineering design issues pertaining to the PlayPumps.

However, we argue that the fundamental problem lies in how the proponents of the project and the supporting organisations, including government organisations and charitable foundations, did not apply CPS approaches. They did not adequately engage in user-focused research by going into communities and observing how people deal with their present conditions, asking what they needed and giving them a part in creating the solution. In other words, the problem was not well defined from the start. There was barely any consultation with the end-users, and no pilot run nor testing was carried out prior to the installation of PlayPumps (Walton 2010).

As a result, poor pump sites were selected, which meant poor water quality or insufficient water. Pumps were financially and technologically unsustainable because they were expensive (costing USD $14,000 each), and the complex mechanism could not be maintained or repaired when they broke down as there was no mechanical expertise in the community where they were situated. In addition, the notion of child labour was socially and ethically problematic. The pumps also disrupted the community lifestyle, where the daily collection of water was a 'networking' opportunity for women in the villages (Stellar 2010).

Perhaps the biggest negative consequence of the play pump solution was that it did not give the villagers the responsibility of owning the solution. There was no plan for the villagers to design, build or maintain the pumps, and consequently the villagers were not encouraged to innovate and come up with improved and creative solutions themselves, especially when the initial solution was found to be unsuitable within the context of each village.

This case study offers an important lesson in ensuring that we learn how to apply CPS strategies to everyday problems. Stellar does however see the positive in the situation when he writes:

> While in many ways PlayPump didn't live up to its original promise, it would be a mistake to be overly critical of the project or its funders. They tried something new, innovative and bold, and learned from the experience. We can continue to learn from it, but let's also focus on what we do next. (Stellar 2010)

Case Study #3: Baby Incubators

Our third case study relates to the crisis of high infant mortality in poor countries. According to the World Health Organization, preterm birth is the leading cause of infant mortality in the world, with sub-Saharan countries being particularly impacted (WHO 2022). The initial solution seemed fairly straightforward when the supply of sophisticated and expensive neo-natal incubators was deemed able to drastically mitigate this problem. However, when 98% of the incubators supplied to these countries—as initial solutions to a pressing global health issue—broke down, there was no available material, expertise or money to fix them. This is concerning for reasons that are similar to the PlayPumps case study above. The problem solvers and designers made the same mistake because when machines broke down, the villagers had neither the materials nor the personal skill to repair them (Payne 2014).

This situation led to a new problem definition: how to build an incubator that can be repaired in the third world? This problem inspired a team of young engineers from Massachusetts Institute of Technology (MIT) in the United States to go to the villages to see what skills were available in rural communities. What they observed was:

- there was little technology: no microwave ovens, DVD players, computers, washing machines or fridges.
- that every community had vehicles and mechanical expertise to repair them. This led to the idea that if they could build incubators from car parts, there would be a ready supply of parts, and of mechanics who could repair broken incubators.

Design that Matters: a non-profit organisation that solves problems for and with the poor in developing countries, led by Timothy Prestero who was part of the MIT team, followed up on the observations made and developed the solution: an incubator called NeoNurture that was made from car parts.[4] This incubator included the following items:

[4] More information on the NeoNurture incubator can be found in the Design That Matters website (https://www.designthatmatters.org/) and in a TEDx presentation by Timothy Prestero (https://www.ted.com/talks/timothy_prestero_design_for_people_not_awards) (Prestero 2012).

- two sealed-beam headlamps that warm the mattress and air around the baby;
- a car air-filtration system that cleans the air;
- a fan that circulates the clean air;
- the car reversing alarm and indicator lights act as warning signals;
- a 12-V car battery and car recharger; and
- small, inflatable wheels that can be mended at a cycle repair shop.

Unfortunately, even though the interests and capabilities of the community were considered, the business case was not, and the car part's incubator was never distributed to the villages. This highlights that it is necessary to identify business constraints *before* a product enters the market. If there is too much focus on user-centred issues, assumptions about product viability may not be detected until late in the process. The NeoNurture Incubator solved the user problem but did not address the business problems, such as who was going to procure and distribute the product (Payne 2014; Prestero 2012).

Although there are no road maps for new ideas, it is important that mistakes are detected and corrected sooner rather than later. All issues should be considered up front, including commercial issues such as technical feasibility, manufacturing capability, the existence of a robust supply chain and a clear route to market, and whether the product will scale quickly or gradually. In this way, the dual approach that looks for the intersection of emerging needs (the "wow" factor) and the capability and assets of the company (the "how" factor) will maximise the market potential of the product (Payne 2014).

NeoNurture managed to address the production issue eventually, which is a great relief. In addition, the supply of low-cost incubators to less-developed countries are now met by several other innovators as well, including the low-cost Embrace infant warmer based on a 2008 project started by a team of Stanford University students (Kite-Powell 2014).[5]

[5] For more information on the Embrace infant warmer, see Embrace Global: https://www.embraceglobal.org/.

Solutions to Wicked Problems

The case studies cited in the previous section of this chapter are historical examples that show the enduring value of Osborn's (1953, 1957) approach to problem-solving. However, in our contemporary era, many complex, novel and open-ended problems appear to defy a clear solution. Tony Proctor (2013) observes a trend toward previously unencountered problems that are without tested solutions. Generally characterised as *wicked*, a term introduced by planning and design academics Horst Rittel and Melvin Webber in 1973, problems of this nature are ill-defined, unique, contradictory and multi-causal. They usually involve multiple stakeholders with various perspectives (Elia and Margherita 2018: 279) and have no clear or unambiguous solutions. Alternatively, they may have an extensive list of potential solutions that require creative approaches towards resolution (Dutta 2018: 493).

Creative thinkers or problem solvers generate diverse ideas by thinking productively rather than reproductively about the problems they encounter (Proctor 2013). Novel ideas can emerge when comparisons are drawn between dissimilar concepts, objects or events. An example is given by Engler et al. (2021), who used the COVID-19 coronavirus crisis as an analogy for anthropogenic climate change. They describe both problems as "super wicked problems" that challenge existing creative problem-solving approaches. For these authors, the crisis of the pandemic offers a useful model for predicting the calamitous potential of wicked problems like climate change. Finding solutions for wicked problems calls for detailed awareness of the crises and their causes. The relative ineffectiveness of standard interventions suggests that novel approaches must be found (Engler et al. 2021: 318). The authors argue that super wicked problems "demand a problem and solution-oriented approach that is continuous in action and generally based around a suite of concurrent interventions, rather than a single predefined solution" (ibid.). Over time, the disruptive impact of these crises is likely to accelerate, with the effect that solutions become increasingly difficult to apply. Furthermore, relevant solutions to such wicked problems are not static or "scalable" but alter in relationship to the intensifying problem and to constantly changing conditions (ibid.). This means that solutions must be continually reassessed (ibid.), or as Rittel and Webber (1973: 160) have explicated, wicked problems are never really solved: in certain instances,

such as governmental planning and social policy, "at best they are only re-solved—over and over again".

Time and the need for behavioural change are important points of contrast and comparison when considering climate change and the COVID-19 pandemic. They are united by the fact that "the time to act is now" (Engler et al. 2021: 318). The escalating scale and pace of climate change threatens to disrupt social and economic systems and potentially overwhelm the regulatory structures that support mitigation and readjustment (ibid.). Behavioural changes are paramount in each instance, yet altering behaviour involves confronting well-established values and assumptions. For creative problem solvers, the conditions of constraint accompanying the pandemic can accentuate the capacity for innovative solutions to arise from the collaborative efforts of multidisciplined or "cross-functional" teams (Sweet et al. 2021: 7). When thinking about global responses to the wicked problem of the COVID-19 pandemic, examples abound both at the level of Big 'C' creativity—such as through rapid vaccine production by companies such as Pfizer, Moderna and Johnston & Johnson—as well as small 'c' creative responses of families and communities to deal with social lockdowns and various health restrictions (ibid.). One prominent example during 2020 was the widespread move towards homemade cloth masks in many communities around the world and the proliferation of YouTube videos showing how they can be made. As Sweet, Blythe and Carpenter note, these are creative solutions that cannot be discounted (2021: 7).

While not diminishing its significance, the COVID-19 pandemic has undermined the luxury of extended preparation time when creatively solving problems. Sweet et al. (2021) draw attention to the significance of preparation when creatively engaging with complex problems. On the other hand, the pandemic has highlighted the simultaneous value of tight time constraints. Nimbleness, flexibility and the acceptance of ambiguity and hybridity are imperative forms of response. Problem-solving involves the ability to pivot from one mode of operation or functionality to another, supported by collaborative endeavour and the strategic use of media and technology (Sweet et al. 2021: 8). Dutta (2018: 494) maintains that wicked problems are not difficult to solve because they are "hard" but because "they are subject to contradictory variables, the issues are complex and tangled, and each problem is unique with little or no precedents." Since wicked problems are indeterminate, actionable solutions call for non-linear thinking. As well as a capacity for quick response,

a key cognitive trait needed for tackling wicked problems is the ability to creatively and productively engage with integrative complexity (Dutta 2018: 502).

The pandemic affirms our ability to respond to wicked problems quickly, creatively and collaboratively. Cohen and Cromwell explain that in the context of the pandemic, creativity involves "any effort to produce new ideas aimed at solving a problem related to the pandemic" (2021: 153). Innovation results when these ideas are developed into products with clear benefits to the user, such as hand sanitiser, ventilators or face masks. People's creativity can be impacted when, as in the case of a pandemic, the environment causes uncertainty about both the problem and its solution. In these instances, the techniques of directed creativity and emergent creativity can assist creative problem solvers to engage with uncertainty in productive ways. The process of directed creativity allows people to begin with a problem that is clearly defined and to use uncertainty as a means of investigating solutions. Emergent creativity presents problem solvers with partly developed solutions, using uncertainty as a way of exploring potential problems (Cohen and Cromwell 2021: 153). For Cohen and Cromwell, embracing uncertainty improves collective problem-solving and assists the development of breakthrough solutions (ibid.).

Mass collaboration is another efficient means of dealing with seemingly intractable problems. This approach arises from the convergence of technologies and social phenomena, and reflects the global reach of the Internet. According to Potter et al. (2010: 398):

> Web 2.0 technologies have enabled the development of distributed collaboration tools like weblogs, wikis, and multi-media discussions that are highly interactive, easy to use, and easy to implement. That large numbers of people are eager to participate in mass collaborative activities has been demonstrated through the success of a variety of social networking phenomena such as LinkedIn, Facebook, Flickr, and YouTube. That, given the right circumstances, large numbers of people are eager to work quite hard to collectively solve difficult problems is proven by the emergence and sustainability of the open software movement. The development of scalable distributed service-oriented architectures, grid computing, and multi-agent technologies has made it possible to design systems which can orchestrate and coalesce the efforts of large numbers of participants, whether they be computers or humans.

According to Potter et al. (2010), the time for mass collaborative problem-solving has arrived. In the digital and technological realms, and at both individual and organisational levels, many would argue that this is already happening. There is little doubt that when we think about the roles that machine-learning programming and artificial intelligence have in helping us solve both current and future wicked problems, our minds boggle at how vast the potential is, and are yet to be fully realised.

Historically, engineers (and engineering students) are called upon to engage with wicked problems. It is generally accepted that these students need to be well prepared for the complex challenges of real-world design (see Bhat 2021). They need to be equipped to work with non-linearity, interdependencies and relationships between disparate variables. In educational settings, the problems engineering students encounter are generally categorised as well structured or ill structured. Well-structured problems present problem solvers with the necessary information to devise clear solutions (Schuelke-Leech 2021: 105). In contrast, ill-structured problems require creative engagement because information about the problem is emerging, partial or unclear. Research by Schuelke-Leech (2021) suggests that in general, undergraduate engineering students in Canada and the United States have limited opportunities to engage with ill-structured problems. The reason is obvious: regardless of the nature of a problem, most solutions require multidisciplinary engagement and practice. As it is not possible for a single person to embody multidisciplinary knowledge, the creative problem-solving process is necessarily enhanced by working in teams, which is the topic of our focus in the next section.

Problem-Solving in Teams

We are all familiar with the saying 'more heads are better than one'. This general sentiment is reflected in large corporations that engage teams to work together solving problems at each stage of the innovation process. The advantage of working with others is that it increases the volume of ideas generated, and since these are more likely to spark further connections, there is a greater chance of generating a broader range that includes quirky, unexpected and off-beat associations. This is particularly important for working with problems within non-linear complex systems as they are generally open-ended and have multiple solutions without any obvious pathway to a best solution. Even Thomas Edison, who is credited with four hundred patents over six scant years, actually headed a team of

fourteen people (Kelley 2001: 69–70). James Surowiecki's popular phrase 'wisdom of crowds' (2004) acknowledges that groups often perform better at decision-making and problem-solving than individual experts. However, this does not mean 'any old group would do.'

Groups or teams function most effectively as a chain reactor of ideas when they are open and participatory. Groups comprised of members who share common backgrounds and experience are more likely to feel comfortable *enough* to share, than if they feel like an 'outsider'. However, they can lack diversity. Research by Cunningham et al. (2021: 1) into the scale and diversity of teamwork in research during the COVID-19 pandemic shows an increase in multidisciplinary teamwork. Attempts to address the global public health crisis have necessitated the revision of pre-existing barriers between some scientific disciplines. According to their review of over 166,000 COVID-19-related articles, Cunningham et al. (2021) found that research teams working on COVID-19-related issues were noticeably smaller yet more diverse than their non-COVID counterparts, comprising researchers from disparate scientific fields. Multidisciplinary collaboration is conducive to creative problem-solving and, according to these authors, highlights an approach to research with possible productive potential beyond the pandemic (Cunningham et al. 2021: 1). There are two important outcomes from this. A group comprised of similar members is less likely to generate a diverse range of ideas, and members are less likely to challenge or offer ideas that contest other group members. In other words, diversity within the group or team is just as, or more, important as the ability of any individual member because it is the key to effective decision-making and plays a key role in moving beyond simple first solutions.

As has been mentioned in Chapter 4, when we discussed the value of brainstorming and group dynamics, teamwork functions best when all members are open, willing to participate, to listen to others and to suspend judgement. A little bit of grit helps too in problem-solving, especially when new or 'left-field' ideas that can be deemed outrageously different are elicited. In 'improv'—short for improvisation that is commonly used in the field of experimental theatre—nobody slows the process down to ask a question or to criticize, however outrageous the scenario (Taibbi 2011). We can further improve the potential for teams to be effective by looking to include members from different age groups and stages in their career, who have different expertise, life experiences and

lifestyles, as well as different genders and ethnicities. This offers a potential range of experience and points of view without being too unwieldy.[6] What this suggests is that the formation of a workable team should ideally satisfy the following broad requirements:

- diversity of membership, in terms of disciplines, perspectives and areas of expertise;
- independence, such that members able to express views that are not influenced by others.

In 2007, the business and economics academic Scott E. Page published a bestselling tome with the central claim that diversity produces benefit. Page's 'diversity trumps ability' theorem (2007) helps explain the importance not just of working in teams to solve problems, but of having diversity within a team. He shows that under reasonably general conditions, a group of *diverse thinkers* can perform better than the *best thinkers* because people from diverse backgrounds will usually provide diverse perspectives and diverse heuristics when approaching a problem (see also Page, 2011, 2012). Page (2007: 162) makes the case that a randomly selected collection of problem solvers can outperform a collection of the best individual problem solvers if:

1. the problem is difficult: no individual is likely to find the global optimum;
2. all problem solvers in the group are smart enough to have perspectives that have a manageable number of local optima;
3. the diversity condition: someone in the team can improve on someone else's local optimum; and
4. the initial population of problem solvers is large.

The takeaway here, from a practice point of view, is that when we are picking members for a team, we should select people who are smart enough (but not necessarily all the smartest) and, more importantly, *different*. Differently put, the thesis here is that a diverse team will have

[6] See also David Alger's popular descriptions of the 'Rules of Improv' (Parts 1 and 2): https://www.pantheater.com/rules-of-improv.html; and, 'How to be a better improvisor': https://www.pantheater.com/how-to-be-a-better-improvisor.html.

more tools and more tools that are different and, by extension, embody creative problem-solving traits.

Creative teams that are diverse tend to be self-organising and dynamic—they change their structure in response to shifts in the environment, and not because of directives from management or a higher authority. Within a corporate context, Kelley argues that "if the boss gets first crack, then he is going to set the agenda and the boundaries, and your brainstormer is immediately limited" (2001: 65). In many cases, the shifts come from changes in viewpoints and the abilities of the members, as they adapt in response to new information that they gain from interacting with other members of the team.

In his book *Group Genius: The Creative Power of Collaboration*, American psychologist Keith Sawyer (2007: 14–17) uses a different perspective that focuses more on the creative and innovative process, to identify the following seven characteristics of effective creative teams:

1. innovation emerges over time: innovation emerges through a sequence of steps, both forwards and backwards, until everybody agrees that an optimum has been reached.
2. successful collaborative teams practice deep listening: team members listen to one another because they are interested in and open to new ideas that could launch better ideas.
3. team members build on their collaborators' ideas: members take up ideas using their own perspectives and heuristics to create better ideas.
4. only afterwards does the meaning of each idea become clear: each member suggests improvements without knowing whether they are useful.
5. surprising questions emerge: this happens when a team member has a different perspective that leads to questions and a re-assessment of the goals of the project.
6. innovation is inefficient: most ideas will lead nowhere, and some that appear to lead away from the best solution may be a stepping stone to better solutions.
7. innovation emerges from the bottom up: innovation begins by finding lots of ideas using a range of different perspectives and heuristics. Ideas develop at random, depending on what other ideas have been placed on the table, and how different people can view those ideas in different ways. Eventually, through the exchange of

> ideas, a highly innovative product emerges that no one member could have imagined from their own perspective.

Sawyer's (2007) case for thinking differently in teams or as groups is not merely a conceptual preference; it is founded in practical social reality. Indeed, along with Sawyer, what creative thinkers like Page (2007, 2011, 2012) and Surowiecki (2004) demonstrate is that diverse teams can outperform talented individual decision-making and problem-solving. As we have already suggested, the key reason for teams performing worse than individuals is due to a lack of diversity. This can lead to several thinking flaws, including *inter alia* (Roberto 2009):

> 1. *groupthink*: team members experience pressure to conform to achieve a unanimous decision, or the social pressure of 'going along to get along'. The pressure of group cohesion exists even where teams are comprised of intelligent and knowledgeable members with good intentions of reaching the best outcomes.
> 2. *confirmation bias*: information is filtered. Support for the prevailing view is kept and information that contradicts it is rejected.
> 3. *cost-sunk effect*: the group is reluctant to 'waste' past effort.

A classic example that demonstrates how these three thinking flaws lead to the premature closure of ideas is the failed invasion of Cuba by American Central Intelligence Agency (CIA) trained rebels in 1961 that became popularly known as *The Bay of Pigs Fiasco*. Michael Roberto (2009) cites this in his study on *The Art of Critical Decision-Making*, and we recount it here as a case study to throw light on why these thinking flaws can lead to dire consequences.

Shortly after John F. Kennedy became the president of the United States in 1961, the CIA approached the Kennedy administration with a proposition to deal with a particular problem: the proximity of a communist country to the USA. Under Fidel Castro, Cuba became a communist state in 1959. The proposal was to invade Cuba at a place called the Bay of Pigs, using expatriate Cubans. A number of meetings were held to discuss this proposition. However, the only solution on the table was a military solution. The CIA had invested so much time in training the Cuban expatriates that they felt committed to push hard for a military option. This example of the *sunk-cost effect* thinking flaw meant that economic and

political options were never considered. To make matters worse, the new Kennedy administration was inexperienced, so it tended go along with the arguments of the senior CIA officials, committing the flawed team process of *groupthink*. As a result, information that would have raised doubts about the decision, and the attendant risks, was either not raised, or was rationalised away, which is a classic example of the thinking flaw *confirmation bias*.

As history tells us, the outcome was disastrous. The rebel force was routed, the US administration was humiliated, and Castro remained in power. The failed invasion may also have contributed to the decision by the Soviet Union, regarded as the arch enemy during the Cold War era, to transport ballistic missiles to Cuba the following year. One positive to emerge from the *Bay of Pigs Fiasco* was that the Kennedy administration learnt its lesson about narrow solution spaces and generated more creative solutions to the Cuban missile crisis in the following year. This was fortunate, as the missile crisis remains the closest that our world has come to entering a nuclear war.[7]

To reiterate, the botched Bay of Pigs invasion by the Americans occurred due to a number of reasons, driven primarily by the aforementioned three thinking flaws. In addition, the team operated with an illusion of invulnerability caused by arrogance and a belief of the CIA's superiority, which led as well to an illusion of morality, since group decisions are perceived as collective and sensible (McShane et al. 2010). The secrecy of the meetings meant that views from outside experts were not sought, resulting in confirmation bias and a high degree of rationalisation and self-censorship. This situation is also known as 'mindguard', which occurs when individuals within the group shield the group from information that goes against its decisions (McShane et al. 2010; Bratton et al. 2010).

Therefore, to avoid situations that could lead to flawed team processes such as groupthink, it is imperative that team processes encourage dissent and debate to generate more ideas, evaluate those ideas critically, identify and test assumptions as well as risks that are hidden. Managing these flaws can lead to positive team environments that can not only enhance

[7] For more information about the Bay of Pigs, visit the John F. Kennedy Presidential Library and Museum at Columbia Point, Boston, Massachusetts, USA. Online information can be accessed here: https://www.jfklibrary.org/learn/about-jfk/jfk-in-history/the-bay-of-pigs.

creativity, they can also generate positive creative problem-solving capabilities.

Conclusion

This chapter follows on from the earlier chapters of the book, particularly Chapter 4, to offer a systematic approach to creative problem-solving. We adopted and adapted Osborn's (1953) creative problem-solving (CPS) model and presented it as a three-procedure approach that can be deployed to address any problem that may emerge in the course of our everyday lives. The three procedures are quite broadly classified as: fact-finding, idea-finding and solution-finding, with each step informed by both divergent and convergent thinking. Using case studies to elaborate on the efficacy of CPS, we also identified common flaws that can derail our plans and desires to innovate and find new solutions.

This chapter opened with the premise that creative thinking, along with the practical application of creative problem-solving, is a critical life skill that is necessary for all human beings to navigate well through life's challenges. Although each of us is bestowed with different abilities, interests, personalities and mastery of skills, there are creative capacities in everyone which can—and should—be harnessed to solve problems that will emerge in our everyday lives. Some of these problems are particularly challenging in that there are ill-defined, unique, contradictory, multi-causal and recurring, which we refer to in the chapter as 'wicked'. Moreover, many of these problems will require us to work in diverse teams in order to genuinely pool our differing abilities, ideas—and draw on our essential *differences*—to creatively solve problems together.

In closing, we reiterate the importance of embracing diversity as we look for greater opportunities to collaborate and problem-solve in teams, while being alert to the pitfalls of groupthink, confirmation bias and sunk-cost effect thinking. Only then can we productively declare that more heads are truly better than one.

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CHAPTER 6

Everyday Dynamics in the Practice of Creativity: A Few Concluding Thoughts

Abstract This chapter draws from Plato's oft-cited saying "necessity is the mother of invention" to help us connect creativity and innovation to the human need to invent, improve and solve problems. At the same time, creativity is also the result of ordinary thinking and everyday dynamics. The chapter then highlights the impact that new technologies have on the practice of and thinking about creativity. It argues that because human involvement is present in the design and creation of digital technologies in artificial intelligence (AI), machine-learning functions and other forms of digital innovation, we should acknowledge them as original forms of everyday creative practice. The chapter concludes with thoughts on how creativity and innovation remain critical in solving future 'super wicked problems' such as climate change and environmental contamination. It is important that every ordinary person brings their own creative energies to spark innovative and extraordinary solutions to problems, however wicked those problems may be.

Keywords Creativity · Invention · Innovation · Technologies · Artificial intelligence (AI) · COVID-19 · Climate change · Wicked problem

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Introduction: Why This Book?

In the opening chapter of this book, we stressed the importance of recognising that creativity and innovation must be studied from the perspective that it is always in-process, ongoing and necessarily disruptive and incomplete. For this reason, we have argued through the course of this book that creativity and innovation are best understood—and lived—as everyday practices that every person is capable of to varying extent, depending on the context, situation and circumstances. It also depends a great deal on one's disposition about the very discourse of creativity and innovation. If we think that creativity is the preserve of the innately smart inventor or the clever innovator, we exclude ourselves and may not be awake to opportunities to experience and partake in the practice of creativity.

The English proverb "necessity is the mother of invention" is attributed to Plato, who wrote in *The Republic, Book II*: "let us begin and create in idea a State; and yet the true creator is necessity, who is the mother of our invention" (in Jowett and Campbell 1894). This well-rehearsed saying has informed much of our thoughts on innovation and the creative process. Indeed, most of us see inventions as human responses to need or necessity, and modern civilisation as an agglomeration of ideas and inventions. Since the industrial age, many of these ideas have been, for better or worse, 'hijacked' by business types who see creativity and innovation as primarily about entrepreneurship and the ability to commercialise new ideas and inventions. Yet, as we have shown through the chapters in this book, creativity and innovation have a much larger scope.

In our contemporary Internet era, creativity and innovation have almost become synonymous with digital technologies. While we are not ideologically opposed to industrialisation, commercialisation or new digital technologies, or indeed of generating and registering patents for new products, we contend that the litmus test of whether something is creative or not goes beyond its ability to make money. Historically, technology has been a catalyst for many new dynamic ideas, inventions and creations, but the creative outputs and technologies that have proven to be successful and ubiquitously utilised by large groups of people around the world are those that pass what we would refer to as 'everyday' tests. Within this category would lie some of the big inventions like electricity generation, the light bulb, telephony and, of course, the Internet. But it would also include 'simpler' inventions like the ballpoint pen, paper clip

and the portable flash drive. In providing a summary of what the chapters in this book have presented and examined, this final chapter thus considers the everyday dynamics that are almost always present in the practice of creativity and innovation.

There is a lot of truth in necessity sparking invention. But at the same time, most people disregard the fact that Plato pays equally strong attention to the genesis of an *idea* that is the precursor to creating and inventing. As we have sought to prosecute across the chapters in this book, creativity does not need to result in an invented product. Creativity can come in thought or in deed, and can manifest itself in many forms and substances. And because it exists in the everyday, the creative process can be deciphered in practice, and therefore theorised such that its approaches and processes can be conveyed and passed on.

As well as unpacking historical and current research on the subject, the chapters in this book have also sought to make the case—in a somewhat surreptitious way—that it is possible to learn how to develop and *practice* creativity. Again, this is because the cognitive mechanisms underpinning creativity are more ordinary than many of us realise. As psychologist Robert W. Weisberg has made clear: "all creativity, including creativity at the highest level, is the result of processes of ordinary thinking" (Weisberg 2014 141; See also Weisberg 2006). In other words, everyday dynamics is what drives the practice of creativity. Hence, as with the title of this concluding chapter, the subtitle of our book emphasises the everyday dynamics of creativity and innovation. It is our desire that this book will offer the reader a refreshed theoretical perspective on creativity and innovation, as well as a sense of how to *do* creativity and innovation on an everyday, practical level.

Reiterations: The Key Points

Chapter 1 framed the background to our study of creativity and innovation by offering an outline of how it has been perceived historically by scholars across different disciplines. As we discussed, although there have been changing conceptions of creativity through history, it is the ordinary, everyday dynamics that stand out.

Chapter 2 explored what we mean by the word "creativity" and ways of approaching the creative process. We explored some of the definitions of creativity, especially how certain values are ascribed to the way creativity happens and the products that result from creative processes. We argued

that the value of a creative act and a creative product is often associated with the reasons behind their development and the needs they aim to address. This chapter also emphasised that the evolution of understandings of creativity has resulted in it being demystified to an extent; everyone (albeit with some help) has the potential to have their creativity developed. We also deepened our discussion of creativity by utilising what Mel Rhodes (1961) termed the 4Ps of creativity: person, place, product and press. We argued that Rhodes' 4Ps offer lenses through which to examine examples of creativity in practice. This chapter emphasised that knowing about what drives and supports creativity can assist in developing a creative practice, ideally for a broader range of people.

The focus of Chapter 3 was innovation and the process underpinning it. We explained what is meant by innovation and discussed some of the framework of an innovative culture. This chapter also examined key types of innovation particularly incremental, radical and disruptive. As we argued, due to the skills required for successful innovations, particular types of team environments and cultures can hasten the development and implementation of an innovative idea. We explored some of the key factors that may play a role in supporting an innovative culture including the spaces where teams work and innovative ideas are developed, the presence of incentives as well as constraints (that can ironically spark innovation via new or lateral forms of creativity). We also made the case for the value of supporting risk-taking and experimentation. This chapter considered the role of crisis—such as the COVID-19 global pandemic that impacted the world for several years from early-2020—in prompting and necessitating innovation.

Chapter 4 turned to what we termed 'prompts for creativity'. These are tools or strategies that can enable, enhance and/or encourage convergent and divergent thinking. As we contended, a creative practice may require a diverse toolbox of creative prompts or strategies that can then be deployed, depending on the situation and problem at hand. We discussed the role of perception in the creative process as well as the importance of employing and being open to ambiguity and contradiction in our creative thinking. The chapter then explained numerous creative thinking prompts including asking questions, analogies, assumption surfacing and provocation, attribute listing, brainstorming, the 6 thinking hats, forced connections, lateral thinking, mindmapping, PMI (plus, minus and interesting), reversal and SCAMPER. Such prompts and strategies are useful

to have in a creative thinking toolbox so they can then be deployed in the creative thinking process as needed.

Chapter 5 extended on the work of Chapters 2 and 4 particularly to discuss approaches to creative problem-solving (CPS). Chapter 5 highlighted the work of Alex Osborn (1953, 1957), specifically his three-procedure approach inclusive of fact-finding, idea-finding and solution-finding. We explained that each step is infused with both divergent and convergent thinking which necessitates asking a number of reflective questions at various stages to support the process of problem-solving. We then explained three case studies (a commercial loyalty program, Playpumps and baby incubators) to illustrate CPS in practice. In these case studies, we identified potential issues that affected the development of creativity and innovation. The chapter also explored what constitutes a 'wicked problem' and some of the inherent challenges in addressing them from a CPS perspective (Rittel and Webber 1973). However, 'wicked problems' have a better chance of having possible solutions generated in particular team environments, especially those that embrace diversity and difference as these are representative of the actuality of everyday life.

Final Discourse: Technologies, Pandemic and Climate Change

In August 2022, Jason Allen, a video game designer from Pueblo West, Colorado won the first prize for a contest for emerging digital artist arts at the 2022 Colorado State Fair for his artwork which he entitled 'Théâtre D'opéra Spatial' (translated as Space Opera Theatre). This sparked a controversy when it was discovered that Allen did not make his entry with a brush or a lump of clay. His 'artwork' was created with Midjourney,[1] an artificial intelligence (AI) program that turns lines of text into hyper-realistic graphics (Roose 2022). A fierce debate ensued about the ethics of AI-generated art, and questions were raised about who (or what) was the

[1] Midjourney is one of several AI-enabled tools readily available online. It describes itself as "an independent research lab exploring new mediums of thought and expanding the imaginative powers of the human species." (https://www.midjourney.com/home/). Image and art-creation AI systems launched in 2022 include: 'DALL·E 2' (https://openai.com/dall-e-2/) and 'Stable Diffusion' (https://stablediffusion.fr/ and https://stability.ai/).

creator? (Tan 2022). Detractors argued that the use of AI apps is essentially a high-tech form of plagiarism, and that Allen should be disqualified since the technology could be deemed the artist, not him. Supporters however took the view that the use of AI to create an art piece was "no different from using Photoshop or other digital image-manipulation tools [since] human creativity is still required to come up with the right prompts to generate an award-winning piece" (Roose 2022).

Regardless of one's moral position, it is not possible to deny the dynamics of human involvement in the creative process, whether this takes place in artistic sketching using actual tools such as paintbrushes or chisels or in the creative input of programming through the manipulation of algorithms, otherwise known as 'machine learning'. The Colorado State Fair episode gives us a significant insight into how technology has and will continue to challenge our thinking around human creativity and what counts as innovative, original creation. As David Tan (2022), a legal copyright expert, makes clear: "it is the presence of the author's [or creator's] own choice or volitional path in the creation of a work—as a result of the conscious mind (entailing rules of logic) and subconscious mind (involving fantasy, imagination, intuition and premonition) working together—that makes a work 'original'." The corollary is that AI-generated works are clearly original—and therefore, deemed creative—as the AI systems are tools or agents that aid the human creator to render ideas into expression (ibid.).

As we unpacked in Chapter 3—especially in drawing from Mel Rhodes' (1961) 4Ps discourse (product, process, person and press), the creative process starts in our subconscious mind, which generates images, feelings and emotions, and then transmits them to our consciousness. We then consciously perceive these images and make decisions about how they can be expressed, not just as an artwork, but in written text or song. The conscious and dynamic comprehension of impulses and enlightenments in our subconscious minds thus perform the function of selecting the form of expression, resulting in the innovative process of (re)producing the creative output (Tan 2022).

There is little doubt that technology has reshaped much of our thinking on and of creativity and innovation quite simply because it is so pervasive in our modern, everyday lives. Those of us living in advanced developed countries are already starting to employ 'smart' technologies that utilise AI and machine-learning functions. These may come in the form of smartphones, surveillance cameras and security devices,

traffic management systems and autonomous vehicles. These have sparked concerns about a contemporary phenomenon known as datafication, which refers broadly to "the quantification of human life through digital information, often for economic value", particularly in the misuse of personal information for mischievous and illegal purposes, such as identify theft and financial fraud (Mejias and Couldry 2019).

If, as we assert, creativity can be mobilised and deployed to solve problems that we encounter in our everyday lives—even wicked problems that demand multifaceted solutions (Rittel and Webber 1973)—then we must remain confident that solutions can and will be found through creativity and innovative practices. COVID-19 is one wicked problem that the world has contended with in recent times. We have witnessed how multiple creative and innovative responses around the world, such as online video-conferencing tools, rapid deployment of vaccines and rapid antigen self-test kits, have enabled many people to cope during the coronavirus pandemic (as Chapter 3 has highlighted). Many other wicked problems have preceded COVID-19, and it is certain that more will come in the future. If nothing else, these problems will ensure the ongoing relevance and importance of creative and innovative practices not only to see us through setbacks, but help us continue to improve and thrive.

The problem of climate change, along with environmental contamination through the excessive misuse of plastics and the growing risk of species extinction, is arguably the most complex wicked problem of our times (Incropera 2015). Like COVID-19, climate and environmental crises have the capacity to disrupt both lives and livelihoods. Yet, unlike COVID-19, they have been decades, even centuries in the making, and are likely to remain destructive to human existence into the foreseeable future. The myriad of problems caused by climate change requires not just creative and innovative responses, but collective action. As Mike Toman from the World Bank has noted, "climate change is an issue that presents great scientific and economic complexities, some very deep uncertainties, profound ethical issues, and even lack of agreement on what the problem is" (Toman, cited in The World Bank 2014). The Swiss international law scholar Anna Saab goes so far as to describe climate change as a 'super wicked problem' because its "causes are multiple and complex, its impacts are uncertain and interrelated, and potential solutions to climate change might well cause further problems" (Saab 2019).

If we are to channel Plato's 'necessity is the mother of invention' mantra into the super wicked problem of climate change, and of environmental problems more broadly, we would adopt an optimistic and *super* creative mindset to the process. Climate awareness and diplomacy have increased substantially, and have taken centre stage in the political arena of many developed economies, especially in Europe. Significantly, while climate change was for a long time the domain of climatologists and geographers, it is now part of mainstream debates in many disciplines (Saab 2019). Although we are a long way off from reaching any concrete resolution, being part of mainstream debates takes the issue into the 'fact-finding' territory (Procedure One) of the creative problem-solving process (Osborn 1953, 1957). Procedure Two, which involves 'Idea Finding' can thus follow and lead us towards Procedure Three, which is where solutions are identified and enacted upon (see Chapter 5). While it would be naïve to think that the super wicked problem of climate change can be reduced into a mere three-procedure approach, it is precisely where we need to make a start. Thankfully, it has already started in several polities and jurisdictions, but more will need to come on board.

As we conclude our brief study, it is worthwhile reiterating that creativity is always in-process, ongoing and is necessarily disruptive and incomplete. And because it occurs at the level of the everyday, every ordinary person will need to bring their own creative energies so as to spark innovative and extraordinary solutions to present and future problems, however wicked they may be.

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