CHAPTER 6

Towards Solving the Impossible Problems

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Introduction

In our world and personal lives, there is a growing need for coherence and resilience. Growing uncertainty and multiplying, paradoxical choices create dissonance, stress and incoherence both in terms of individual and environmental wellbeing. Correspondingly, sustainable choices improve coherence of natural and social systems. Achieving internal and external coherence and sustainable behaviour is above all a decision-making challenge. Coherent decision-making is seen as the key to sustainable wellbeing at all levels of society (Hämäläinen 2014).

But how can we make better decisions? Complex problem solving is not easy in the best of circumstances, and increasing complexity of today's problems causes difficulty when trying to foresee or predict the full effects of one's decisions. Living amid uncertainty and still being able to make decisions in confrontational situations requires various internal competencies. For example, resilience, foresight, systemic intelligence, willpower, self-regulation and emotion control are important. Further, intra- and inter-personal attunement as well as compassion and empathy are essential skills.

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However, the main barrier to better problem-solving is often the human brain, due to its limited capacity to problem solve in certain conditions. Recent research opens up new perspectives on the human mind, the possibilities of knowing as well as the personal capacities necessary to creating, discovering and inventing. In this chapter, I explore these issues from the perspective of internal knowing, or intuition. We will start with a closer analysis of problem solving and ways of knowing.

Wicked Problems and Collapsing Time Frames

Problems are usually divided into three major categories: well-defined problems, ill-defined problems, and *wicked* problems (Rittel and Webber 1973). The most challenging type of problem is a wicked problem. This type of problem cannot be exhaustively formulated, hence, there are many explanations for the same problem and every formulation is in some way a statement of a solution. The solving process is infinite—every problem is a symptom of another problem, and every solution usually leads to a new problem. It is difficult to know what components of a problem are relevant and what information will be useful until a solution is attempted (Lawson 1997). Every wicked problem is unique, so neither previous experience is particularly instructive nor can a list of previously successful operations be utilized. In many situations, like climate change, the problem is urgent, there is a need for immediate action, and problem solvers have little space to be wrong (Rittel and Webber 1973) (Fig. 6.1).

Every wicked problem has a structure of its own. Tame and *wicked* problems are not governed by the same logics. The strategies developed to combat tame problems are not just different in degree, but above all are different *in kind* from wicked problems, which have a complexity, ambiguity and epistemological uniqueness of their own (Nelson and Stolterman 2003). In addition, there is no single correct approach or methodology for finding, defining or solving wicked problems. In an effort to solve one part of the problem, the whole setting transforms and new problems arise, often more challenging in nature because they are an underlying issue producing superficial symptoms.

With wicked problems, an attempt to intervene in it is generally a better option than doing nothing at all. In an uncertain world, forethought combined with quick reaction—being prepared and ready—is thought to

PROBLEM TYPE	CHARACTERISTICS	SOLUTIONS
WELL-DEFINED PROBLEMS	Goals known Constraints known Solutions known Success criteria known Optimal solution	The solution can be optimized
ILL-DEFINED PROBLEMS	Problem? Solution? Success Criteria? Multiple solutions	Solutions cannot be optimized but can be satisfactory
WICKED PROBLEMS	Incomplete, no formula Contradictory Changing Definition No stop rule Unique, no cases Solution >> a new problem Unknown/No optimal solutions	Solutions can be at most actionable

Fig. 6.1 Well defined, Ill-defined and wicked problems. Illustration inspired by Rittel and Webber (1973)

be beneficial. This is because behind many errors is the inability to anticipate. Often, a transformative change has not been seen or recognized even though it has unfolded in front of our eyes. How could we better foresee, or consciously notice those changes that demand action? And what kind of action should we take?

Humankind is facing a full spectrum of wicked problems and the window of opportunity for solving some of them appears to be closing. It is not easy to recognize that the prevailing scientific paradigm predefines future problem spaces, which then narrows possible future solutions. In other words, we tend to start considering solutions based on what we already know to exist, or is deemed possible. *We are thus prone to ignore potentials we consider impossible*. However, many problems have been considered impossible—until they are solved.

To search for radical breakthrough innovations, with extreme novelty, searching beyond the current paradigm is crucial. To be able to solve wicked problems, we must find ways to surpass the limits of the known; rational and analytical thinking is not enough.

In complex problem solving, the analytical mind can be overcome by too many options. It struggles when there is a lack of information or when it cannot push beyond imagination to envision entirely new options. A person is often not even aware of a lack of information or what could be known. In the worst case, there is simultaneously an overload and a lack of information, compounded by critical time limits for making decisions. But evidence and history suggest that when faced with such constraints, intuitive faculties can operate with greater accuracy than conscious reasoning. (Dijksterhuis et al. 2006; Frank et al. 2006; Gigerenzer 2007; Klein 1998).

Most wicked problems are entangled knots with countless variables. Further, while the world continues to change ever more rapidly, everyone, especially students need to be prepared to handle the future's as yet unknown configurations (Marton 2014).

Even though technological development is important and transformative in terms of its impact on society, it is not enough. Implementing new technological solutions will not solve the problems humanity is facing. Technology is not even satisfactory when trying to predict changes waiting just beyond the horizon.

Philip Tetlock, a professor of psychology, has been researching political forecasting and prediction for more than 20 years. Tetlock states that predictions formulated by expert forecasters are not better than darts thrown at a board of possible futures. However, his research shows that some ordinary people do have real foresight. These people achieve 30% higher accuracy than *all* US intelligence services utilizing sophisticated intelligence gathering and analysis tools (Tetlock 2015). What makes

these ordinary people so insightful that they can be labelled 'superforecasters' by Tetlock?

The main principles are simple. They keep their minds open instead of implementing a certain style, method or viewpoint. They are curious, not limited by dogmas and collect information from diverse sources. With challenging issues, they split the phenomena into fractions that they can scrutinize, and then allow contradicting views to merge into a whole picture.

Superforecasters also pay careful attention to their internal knowing including untethered thoughts and feelings. They test everything since their most important ability is self-distance and learning from their mistakes. Further, they construct and transform knowledge with others, knowing we can learn to be wiser when confronted by other viewpoints (Tetlock and Gardner 2015).

Currently, solutions for complex decision-making, forecasting and wicked problem solving are sought through increasing the capacity of computing. Ever larger quantities of information are acquired and analyzed. But the core challenge is not increasing the quantity of information, but instead being able to discern what is valuable; as well as to recognize and create the right connections between disparate pieces of information.

Wicked problem solving and radical breakthrough innovation calls for new thinking skills. It requires various forms of resilient intelligence and clever ways to construct and integrate information together. But let's start with a question: how can we *know* in the first place and how do we form knowledge?

To Be Smart, Integrate Diverse Forms of Knowing

There are four different ways of knowing and acquiring information: through authority, reason, experience and *noetic knowing*.[1] In schools, information transmission is mostly based on the first two, authority and reason. These can be called external ways of knowing. Even though experience is a common way of knowing and learning, it is not usually well integrated into formal education. Noetic knowing is in turn mostly excluded from education. Experience and noetic knowing can be labelled as internal ways of knowing. Intuitive information is embedded in these two forms of knowing.

Currently, the term *intuition* is used as a common label for completely different types of information, varying processes and diverse outcomes that are not always clearly identifiable. The term intuition is used to describe different *types of knowledge*, for example subconscious knowledge, instinct, embodied cognition or expertise-based information. It describes *experiences* such as 'something is not matching,' or *sensations* such as goose bumps and gut feelings. The term intuition is also commonly used to describe various *processes of intuiting*, such as emotion-based action, non-verbal sensing and direct knowing. Further, it is also used when talking about the *outcomes or results* of a thinking process. These can be, for example, ideas, insights, inspirations or visions.

The incoherent terminology illustrates well how unformed understanding is in this area. In this chapter, I use both terms internal knowing and intuition when referring to knowing related to the internal and intuitive faculties of mind. Nonconscious describes the opposite to conscious mental operations.

These four modes of knowing have their benefits and impediments; they may not only offer valid and reliable information but also contain vague, unreliable or false information. Therefore, it is essential as with all types of information, that we have transparent methods to evaluate the reliability and accuracy of information.

In order to construct best possible knowledge basis for new knowledge creation, we need to integrate diverse kinds of information. The scientific method is '*a way of combining these various approaches to understanding so that their weaknesses tend to cancel each other out, but their strengths tend to add up*' (Tart 2009, p. 42).

Why Develop Intuition?

In order to know more about the potential of internal knowing, we need to take a closer look at how the human mind works. Intuition is an integral part of human cognition and the nature of the human brain is inherently intuitive. The human nervous system comprises a complex, multi-layered and distributed network of billions of cells acting in myriad ways and most of this processing is nonconscious, i.e. intuitive (Laughlin 1997).

According to prevailing understanding, human cognition is based on a dual process model of the mind. The two faculties of the mind, conscious reasoning and intuiting, are integrated and work in constant cooperation (Kahneman 2011; Kahneman and Tversky 1982).

Intuitive—or nonconscious—faculties of mind are in constant communication with the environment. Intuition supports consciousness by limiting the amount of incoming information, so that consciousness—or reasoning—is not overwhelmed. If compared with reasoning, intuition handles several magnitudes more information at any given time (Lipton 2012; Zimmermann 1989).

The nonconscious selects perceptions and passes them to reasoning faculties for closer evaluation. This means that reason is supported by and in fact *requires* nonconscious cognition in order to be free to work on the kinds of problems it is well-designed to solve. For example, to analyse, compare and classify (Hayles 2014; Lipton 2012).

Typically, intuition is considered prone to biases and this is true with some forms of intuitive thought, but this is not the whole truth (Kahneman and Tversky 1982). Several studies emphasize that some intuition can be evaluated for reliability and accuracy, intuition can be used intentionally, and it can even give exact and detailed information. Therefore, intuitive processing needs to be developed and used intentionally—just like conscious reasoning and analytical thinking—to result in more reliable outcomes (Davis-Floyd and Davis 1996; Kautz 2005; Monsay 1997; Root-Bernstein and Root-Bernstein 2003; Shefy and Sadler-Smith 2004).

In an optimal situation, internal and external ways of knowing can be integrated. It is not a question of internal knowing *versus* conscious reasoning, rather of intuition *and* rationality (Dunne 1997; Shefy and Sadler-Smith 2004; Surel 2007). Combining reasoning and intuiting can result in beneficial knowledge of many kinds. This has been acknowledged for decades in several fields of knowledge such as mathematics, business, linguistics, design, creativity, decision-making and innovation (Agor 1989; Bastick 2003; Bunge 1962; Fischbein 1987; Raami 2015). However, formal education still focuses firmly on the development of reasoning faculties or external ways of knowing.

What Can We Learn from Design Research?

Intuition is the driver of innovation and creative ideas involving extreme novelty. Design studies have a long tradition of researching iterative, cyclic and intangible aspects of designing, such as distributed cognition, building knowledge structures and sharing expertise. In these studies, design is frequently mentioned to be one of the most challenging

cognitive tasks since it operates in the area of complex problem solving (Buchanan 1992; Goel and Pirolli 1992; Laamanen and Seitamaa-Hakkarainen 2014).

Expertise in design seems to be different from other forms of expertise, since many creative experts define and manage problems by keeping them under-specified, while other experts tend to solve problems by adopting the most rational approach (Cross 2004). Many talented designers do not concentrate excessively on problem analysis, rather they let their expertise and intuition focus on quick problem scoping and sketching. In this process, sketching becomes a tool for understanding the outlines of problems, which then feeds idea generation. For these reasons, design expertise is frequently identified differently in terms of its problem structuring, formulation and solution-generating approach (Cross 2004).

Designers frequently underline the importance of intuition in their creative process; not without criticism from other professions. However, there is a lot of variation in how designers describe their intuition or the methods by which they benefit from it. For example, intuition can filter usable outcomes from numerous amounts of raw data, give new directions to possible solutions, stimulate formulation of new ideas, connect surprising perspectives or exceed the limits of conscious reasoning (Raami 2015).

Several studies suggest that the most talented design students use more intuitive faculties while working and that they are more capable of using different cognitive styles and easily switch between them (Cross 2004; Schön 1988). Further, intuitive thinkers use fewer stereotypes than conscious thinkers, since it is hard to avoid 'jumping to conclusions' when a person thinks consciously (Dijksterhuis et al. 2006). The need for certainty may lead to premature generalization or ignoring information that contradicts personal bias. The students who think holistically seem to benefit from easy access to different modes of thinking, which creates a head start compared to analytical thinkers (Roberts 2006).

Design knowledge tends to emerge from conscious not-knowing, or unlearning, therefore, in the process of designing, an initial state of intentional ignorance or emptying of the mind is needed to be completely open up to alternative possibilities. Since design strongly intertwines reasoning and intuiting, the chosen means to acquire knowledge directly affect knowledge production. Whether the information is acquired and processed through intuition, or analysis leads to different

types of knowledge construction, the form of inquiry leads to a specific body of knowledge since it influences the constitution of the knowledge and what is gained through the process (Nelson and Stolterman 2003).

What Can We Learn from Nobel Laureates and Other Visionaries?

Scientific intuition seems to be a special type of intuition since it is able to simultaneously grasp the whole while being rooted in profound knowledge of its individual parts (Marton et al. 1994). Typical to domain-specific expertise is the ability to surpass the limits of single cases and perform mental operations on a more abstract and conceptual level (Cross 2004; Ericsson 1999, 2006). These processes are embedded in intuitive faculties of mind. Numerous case studies emphasize that intuition is the primary thinking mode used for discoveries and inventions while conscious reasoning is used for argumentation.

The development of emerging professional expertise requires usually at least 10 years of active practice. At this point, the delving results in the accumulation of several cognitive resources: a case example database, personal experience and personal mental models in nonconscious faculties. The development of expertise continues, but it constantly requires dedicated application of the individual, otherwise performance will be modest (Bereiter 1993; Ericsson 2008; Gladwell 2008).

With robust expertise, a person can utilize a large subconscious database of information, including tacit and embodied dimensions. The cognitive processes that experts typically exploit include: varying pattern matching and recognition processes, accumulation of evidence, random sampling or automatic construction of mental representations. The information may be derived from memory traces combined with new information, mental representations or comparison with exemplars, prototypes or images. Often the processes to construct or interpret knowledge is completely nonconscious and only the result enters awareness (Glöckner and Witteman 2010).

In addition, intuition correlates with empathy, which can be understood as a form of acquiring information, where, through the perception and feelings of oneness, a person can perceive sensations that come from outside personal experience. Typically, intuitive individuals have sufficient empathy with a problem, including caring for and involvement

with a specific context. This setting enables a person to create a sensitive personal relationship with and a degree of command of the issue (Bastick 2003).

Further, those experts who are capable of exceeding the boundaries of prevailing knowledge seem to benefit some other types of cognition too. Research made on Nobel laureates and distinguished inventors have recognized a cognitive category labelled extra-cognitive abilities. These refer to phenomena such as internally developed and highly subjective standards, norms, intentions, beliefs, preferences and values. Parallel with other types of experts, these individuals deeply enjoy working and are passionate about their area of study. This manifests as continuous curiosity, questioning attitude and the use of intuition (Shavinina 2009; Shavinina and Seeratan 2004).

For these people, excellence is a *virtue*. Further, they employ self-regulation skills including the ability to monitor their mental and emotional dimensions. Their level of self-esteem, courage and ability to tolerate loneliness are high. And of course, many of them are challenging personalities with highly personal ways of working and processing information (Shavinina 2009; Shavinina and Seeratan 2004).

Working "With Self" and Integrating What You Saw

Case studies of Nobel laureates reveal some characteristics that are common to these visionary individuals. Many of them underline the role of visual intuitive experiences and the importance of 'seeing.' Some describe seeing as a way of perception, for example, imagining being immersed within the research project. Others describe the act of seeing as visualization and active use of the imagination including handling multiple dimensions. Further, several report having exceptional ways of working and accessing information, including, for example, feeling '*united*' or having experiences of direct knowing (Holton 1978; Keller 1983; Larsson 2001).

Nikola Tesla has often been mentioned as the most impressive example of a user of mental imaging. Tesla's mental images of inventions were so vivid that he could run the detailed mental models in his mind for weeks and examine them with his *mind's eye* (Monsay 1997).

August Krogh, a Nobel laureate in Physiology or Medicine, developed a considerable part of his work while lying in bed in the evening, trying to imagine processes and experiments. His fruitful ideas came seemingly

out of the blue but he worked with them consciously. He never made sketches prior to completing the arrangements of his thoughts, since he felt they would hinder the free flow of ideas (Larsson 2001).

Robert A. Milikan, who was awarded the Nobel Prize in Physics, saw electrons. He trained to develop intense powers of visualization, which assisted in drawing conclusions; and behind these, an unanalysed, yet preconceived, theory about electricity, which gave him a lens with which to look and interpret his observations (Holton 1978).

Hideki Yukawa, who received the Nobel Prize in Physics, often lay awake at night thinking about the problem of the forces holding together the nucleus of the atom. He had a notebook beside his bed and one night, an insight came to him: there must be a relationship between the intensity of the force and the mass of the binding particle. On the basis of this idea, he found a particle he called a 'meson' (Larsson 2001).

Linus Pauling, a Nobel laureate in chemistry, solved the mystery of alpha keratin molecules while forced to stay in bed with a heavy cold. He floated the ideas freely in his head and continued sketching images of the molecule on a page, which he folded at the points where the molecular structure would allow it. After several attempts, he succeeded in forming a pipe-like structure that enabled the spiral form. He has described the hunches or inspirations that come to him as the result of training his unconscious mind to retain and ponder problems (Larsson 2001).

Albert Einstein was led to the idea of relativity by the vision of travelling on a light beam (Holton 1973, p. 358). Einstein's mathematics was to be '*seen*' and to him '*the objects with which geometry deals seemed to be of no different type than the objects of sensory perception which can be seen and touched*' (ibid., p. 638).

Barbara McClintock, a researcher of corn genetics and Nobel laureate in Physiology or Medicine, practised intense and systematic observation and interpretation for years. She had built a theoretical vision, a highly articulated image of the world within a cell. McClintock described her experience of knowing as a '*feeling for the organism*.' As she watched corn plants grow, or examined the patterns on the leaves and kernels, or looked down the microscope at their chromosomal structure, she saw directly into an ordered world of mental images.

McClintock's way of perceiving information was strongly based on visual perceiving, yet included some other dimensions. She called her system, '*integrating what you saw*.' She simultaneously read the environment with her physical eyes as well as with her mind's eye. The physical

spots McClintock saw on the maize kernels represented for her a hidden genetic meaning that she could read simultaneously. For McClintock, the eyes of the body *were* the eyes of the mind. Sometimes, McClintock described the material as '*not integrating*,' which meant there was something wrong—an experience described also by many other professionals (Gigerenzer 2007; Klein 2004; Keller 1983).

Through describing these experiences, McClintock spoke about the deepest and most personal dimension of her experience as a scientist. She also spoke of the '*real affection*' one gets for the pieces that '*go together*.' '*As you look at these things [chromosomes], they become part of you. And you forget yourself. The main thing about it is that you forget yourself*' (Keller 1983, pp. 115–117).

McClintock explains that she doesn't know how she is able to know, she describes having always having an '*exceedingly strong feeling*' for oneness. '*Basically, everything is one. There is no way in which you draw a line between things. What we [normally] do is to make these subdivisions, but they are not real*' (Keller 1983, p. 204).

The examples above demonstrate the importance of various forms of perceiving and processing information while making breakthrough scientific discoveries. The ability to see things in various forms through varying methods—even though they exist only in one's mind is an important resource for all creative work.

Some of these experiences described above have similarities with flow experiences containing highly focused states of consciousness, working on the edge of one's competence as well as effortless performance (Csikszentmihalyi 1996). Several of these visionaries report benefiting from relaxation and meditation. Nobel laureate Dag Hammarskjöld even created a meditation room in the UN Headquarters. Some also mention altered states of mind or extraordinary experiences (Larsson 2002).

One of the most important aspects is that studies of Nobel laureates reveals that when facing a truly difficult problem, instead of working excessively on the problem itself, these individuals report starting to work with *themselves*. In other words, instead of collecting additional information and analysing it, they turn inwards. However, they cannot explain in detail what actually takes place (Keller 1983; Larsson 2001).

In order to share these highly personal insights and construct knowledge in teams, it requires a shared language. Based on vision—our most public and our most private sense—it gives rise to a kind of knowledge that requires more than a shared practice to be communicable: it requires a shared subjectivity.

There Is Vast Untapped Potential of Internal Knowing

The way the human body and mind work is ingenious. At any given time, there is a continuous and extensive information transfer process going on. Even though recent research has made remarkable progress in this area, the truth is, there is more unknown than known about how information transfers or is stored inside the human body. However, different fields of knowledge can enrich our knowledge related to the processes of inventing and intuiting.

Recent neuroscience studies state that before insights are generated, there is a change in focus that quiets visual input and switches attention to internal activation. Even the smaller 'Aha!' experiences are preceded by a switch to internal attention and activation of nonconscious. These studies suggest that it may be that any behaviour that encourages quieting of thoughts can be helpful in gaining insight. This process seems to be similar to a large domain of cognition that also handles perception and language processing (Bowden et al. 2005; Jung-Beeman 2008).

Psychological research outcomes emphasize that intuition is embedded in varying cognitive processes. A *clicking-in* type of experience follows a period of intense concentration whereas a Eureka experience is preceded by a period of incubation and inattention. In other words, a Eureka experience is embedded in re-centring—an experience of new permutations of relations between ideas and a novel and unconventional combination of thoughts. Typically, a coincidence in the physical world acts as a spark and causes a mental process leading to a Eureka experience. The classic examples are Newton observing the falling apple, Archimedes taking a bath and James Watt watching a kettle boil (Bastick 2003).

When observed from the perspective of biology, the transfer of intuitive information is not limited inside brain. For example, the human heart has neural cells that may store short-term and long-term information independently of the brain (McCraty et al. 2004a, b). This is aligned with research involving heart transplant patients that suggests that the heart may store very detailed and accurate information that can be transferred with the organ (Pearsall et al. 2005). Further, the intestines and stomach have neurons of their own too (Gershon 1998; Järvilehto 2015). Therefore, trusting gut feelings or heart's sensations may have a scientific, biological foundation we have not been fully aware of.

From the intuition research perspective, or when taking a closer look at individual experiences through case studies, there emerges a vast

spectrum of experience. The designers I have researched and coached report having intuitive experiences varying from small hunches, flashes or feelings of promise to more profound sensations such as complete visions, experiences of serendipity, or large quantities of inspirational material taking on a life of its own. Some designers describe even highly personal, extraordinary experiences, which may challenge their personal world view and way of thinking (Raami 2015). Even though the research does not explain the foundations of such experiences, the experiences themselves are significant, since they underline that creative individuals are able to harness their intuition and apply it to the creative process.

Among designers, many can recognize different '*sources*' or '*origins*' of intuition. During these moments, they typically feel that they are at their most creative. There is a strong feeling of '*receiving*' ideas, being energized or '*carried*' and being empowered. Many of these people report a qualitatively different experience between '*receiving ideas*' and the experience of forming ideas based on own imagination (Raami 2015).

Indeed, intuition may originate from various sources. The process of intuiting may be based on the various forms of knowing mentioned above. It can combine different sources of information coming from the mind, body, thinking, memory, environment, feelings, embodied cognition, senses or extended senses. Typically, intuition is entangled with expert knowledge. However, sometimes intuitive faculties of the human mind may know something that the reasoning faculties are not at all aware of; research, for example in the area of presentiments, strongly supports this proposition (Bechara 2004; Bem 2011; Dossey 2013; McCraty et al. 2004a, b; Radin and Sheehan 2011; Sheldrake 2011).

All of these perspectives from different fields of knowledge underline the possibilities of internal knowing. In order to benefit from or develop intuitive faculties, it is not necessary to have a fully resolved explanation of how the human mind or intuiting works. It is enough if it works and can provide certain benefits. Further, cutting-edge research challenges the boundaries of knowing, so even if explanations existed now, they may be out-dated as science advances in the coming years.

Are the Boundaries of Knowing Crumbling?

What we know and how we know it is not an easy task to research. For example, neither neuroscience nor genetics can extensively explain where information is stored or how it is retrieved (Powell 2009).

In the area of physics as well as in anomalies research, some experiments challenge the prevailing scientific paradigm. For example, some research suggests that at times a person is able to access information that exceeds the boundaries of expertise and surpasses even the limits of time and place (Powell 2015; Radin 2008; Radin and Sheehan 2011; Sheldrake 2012; Targ 2012).

Due to the recent increasing number of such unconventional research outcomes, some hundreds of accredited scholars from various fields of science have been calling for an open study on all aspects of consciousness, including the inexplicable subjective dimensions of human experience (Beauregard et al. 2014; Cardeña 2014). At the moment, the biggest barriers are the lack of funding and hidebound attitudes.

Several studies on the history of modern science show that many brilliant ideas come to people who are in some sort of intuitive or altered state—for example dreams, reveries, extraordinary insights, meditation, or drug-induced states—seemingly out of the blue (Bastick 2003; Holton 1978; Larsson 2001). It is significant that these experiences have resulted in exceptional and remarkable outcomes. For example, Larry Page, who founded Google, has described being awakened at night with an idea: what if he could search all the information from the Internet and present the results only in one page. He wrote the idea quickly down since typically thoughts between dreams have faded in the morning. In these experiences, information is received in a form of clear thought or an idea resembling a download experience.

Studies of highly intuitive individuals play an important role in revealing the potential of the human mind by unfolding and demystifying the process of intuiting. Highly intuitive individuals have marked out a pathway toward intuition development, especially by exceeding the limitations of accessible information as well as by exposing the methodology of intuiting.

The more unexplainable the personal experiences are, the greater stigma they tend to carry. Highly personal or extraordinary experiences are not shared. The experiences may be consciously ignored or explained away due to a couple of reasons.

Firstly, no-one wants to be laughed at or ostracized. For example, Nobel laureate McClintock was a highly respected scientist by peers until around 1950s when her thoughts started to significantly differ from the mainstream. In scientific conferences, her lectures were marked by silence since nobody understood what she was talking about. Colleagues

started to laugh at her behind her back and 'mcclintocknism' became a synonym for an unscientific approach. In 1953 she quit all academic publishing due to severe criticism. It was only in 1980s when she was rewarded with a Nobel Prize that it was evident she was far ahead of her own time. Historically, she has been the only woman awarded an undivided Nobel Prize in medicine (Keller 1983).

Secondly, the human consciousness can bend, shrink or even split, but it cannot tolerate a break in coherence (Hayles 2014). This leads to a situation where consciousness easily edits and modifies reality to fit personal expectations, at the cost of a more accurate rendering of reality, by misinterpreting anomalous or strange situations (Hayles 2014). This may result in ignoring or shutting out anomalies even before they reach the conscious. In other words, if our mental compartments are not open enough, we cannot escape our current thinking models. We perceive only those perceptions that fit our current mental models and filter out others.

When facing extraordinary information, it may lead to a situation where intuitive information strongly contradicts an individual's current understanding or beliefs. These situations require mental resilience, since it is emotionally challenging to handle a situation where incoherent pieces of information conflict—yet at the same time they coexist.

This situation is a double-edged sword: on the one hand, intuition is prone to biases when an immediate pattern recognition process matches the current situation to previous ones stored in memory (meaning WYSIATI what-you-see-is-ALL-there-is), resulting in misinterpreting the current situation (Kahneman 2011). On the other hand, the conscious mind may edit reality by ignoring some perceptions. This highlights the importance of authentic perceiving, which can be developed with practice (Shefy and Sadler-Smith 2004).

What Is Intentional Intuiting?

As described earlier, reasoning faculties operate with low speed and have extremely limited information processing capacity when compared to intuitive faculties. Intuitive faculties can filter enormous amounts of raw data, while reasoning focuses, analyses, estimates and compares at slow pace. These two compartments are highly specialized and work in perfect balance: intuition picks important perceptions and passes them onwards to reasoning faculties for further elaboration (Hayles 2014; Lipton 2012).

However, it is important to note that many references suggest that this process can be overturned: the conscious mind can be used to acquire specific information from intuitive faculties through intentional intuiting (Kautz 2005; Raami 2015; Targ 2012). When a person considers a task, not only the conscious but also the nonconscious faculties of the mind start acquiring and processing perceptions and information in line with the intention (Lipton 2012).

Research with highly intuitive individuals suggest that it may be possible to acquire diverse kinds of information through intuitive faculties (Kautz 2005; Peirce 2013; Targ 2004, 2012). But, how in a practical level can one harness intuition as part of a cognitive process? Even though intuiting happens outside of rational cognition and is not fully understood, there are some parameters we know through research in various fields. Figure 6.2 illustrates this process step-by-step.

The foundation of intentional intuiting is the ability to wonder. It is beneficial to start with a playful and questioning attitude '*what if*' or '*could it.*' Designers famously use question-prompts such as '*how might we*' (known as HMW questions) to provoke an exploratory thought and design process. The resulting hypothesis can vary from moderately challenging to entirely implausible, depending on how pragmatic or radical one wants to be.

When attuning to intuition, a prerequisite is openness of mind—known colloquially as *the ability to look at something with a fresh set of eyes.* Typically, we bring to situations a ready mind-set and a tendency to uphold pre-existing understanding of problems. From this starting point, we easily lock and narrow our thinking in a way that precludes perceptions and alternate possibilities.

It is very challenging to pose in one's mind a totally new position and radically different viewpoint. If it was simple, we would not have insolvable problems. Solving the impossible problems means we must consider it somehow possible in the first place. However, sometimes it is so difficult to set the mind in a new position that it is easier to label the problem *impossible.* To overcome this, integrating playful attitude and intention can ease the process.

The moment of intuiting may take place accidentally—Eureka! Experiences—but it can also be acquired intentionally. At this phase, the ability to perceive becomes the most important: what type of sensation, hunches, feeling or images are we are able to let enter our minds? With practice, a person can develop their sensitivity to varying types of

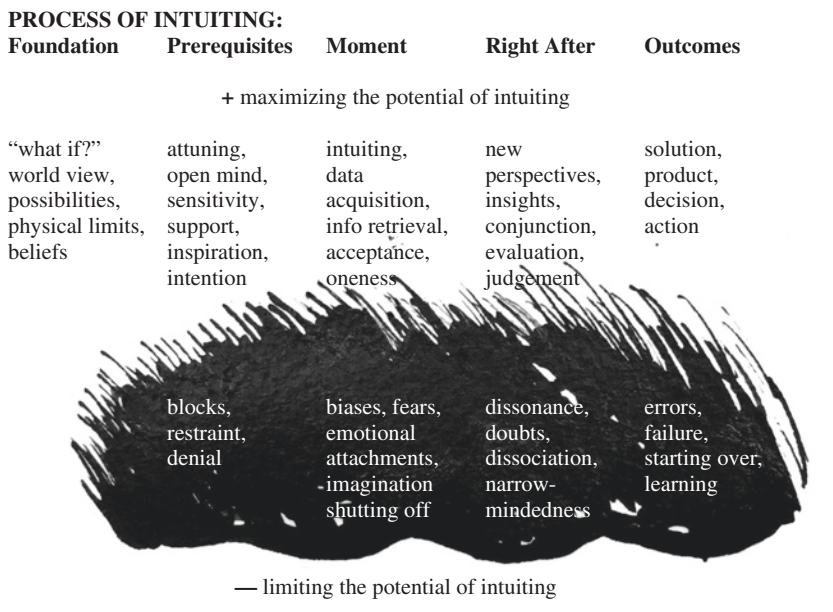

Fig. 6.2 Maximizing the potential of intentional intuiting (Raami 2015)

stimuli. This is essential since intuiting is a way to access multidimensional information.

The moments after intuiting are closely intertwined with the act of intuiting. Often, it is not easy to perceive a difference between these two since intuition is extremely rapid. This phase is probably the most vulnerable part of the process since insights generated through intuition can seem untethered from anything known. It is not until this moment that intuitions can be consciously noticed, verbalised or shared with others.

At this point, intuitive insights can be discerned from biases or other untrustworthy signals; however, this requires good discernment skills.

Intuition happens outside of logic and is accessed and grasped internally; therefore, it cannot be evaluated only with reasoning and analysis. Discernment is an individualized competency requiring individuals to develop their own specific methods.

Information retrieval through intentional intuiting does not require the application of intuitive information. In other words, acquiring intuitive information does not mean we are forced to think or act based on intuitive information. Before bringing intuitive information into a decision making process, it can be evaluated, tested, compared or integrated with information acquired through other means.

Failures and mistakes are important. Without making mistakes, it is hard to develop intuiting to its full potential. In the case of failure, the process can be just restarted. In optimal cases, intuitions and insights lead to new knowledge, new practices and breakthrough innovations. And, in all cases, they lead to learning.

In summary, it is beneficial to collect all intuitive information before turning to reason, partly because analyzing intuition rationally has been shown to reduce the accuracy of intuitive judgements (Nordgren and Dijksterhuis 2009). Further, intuitive information appears in ambiguous, multidimensional or non-verbal form and needs fresh eyes and open mind to be successfully captured. After information retrieval, intuitive impressions need careful formatting and skilful verbalization before they can be understood or shared.

How to Support Intuiting in Practice?

Now let's elaborate the moment of intuiting and the moment right after. Sensing more delicate signals or discerning the correct signals out of noise is not always easy, but it can be practiced. However, it may be time consuming since there are various types of intuitions and the whole process of intuiting is embedded in complex and unknown processes (Claxton 2000; Hammond 2007; Hogarth 2001, 2008).

I have been working in the grass-root level of creativity and intuition coaching for more than 10 years, running Coaching Creativity courses for university-level students since 2003 and Coaching Intuition courses since 2008.

Based on personal professional experience, intuition coaching can result in both applicable and exceptional results. However, the coaching challenge is generally not actually to develop intuition, but rather

Fig. 6.3 The components supporting intuiting (Raami 2015)

to enhance cooperation between the two faculties of mind: conscious reasoning and intuition. In other words, intuitive faculties do not need developing, but the process of intuiting does. To benefit intuition, it is indispensable to train the mind to be less resistant and more accepting towards the unknown, uncertain and ambiguous.

Intuition cannot operate in the narrow or linear compartment of rational cognition. Intuition operates in a multidimensional information space. Therefore, the rational compartment of mind needs to be slowly expanded. In coaching session, we can perform drills to enhance the skill of perceiving and discernment, which work as a link between conscious reasoning and intuition.

The main components of supporting the process of intuiting are illustrated in Fig. 6.3. The process consists of three continuous and rotating steps of development: expanding the boundaries of the mind, developing perception skills and developing discernment skills. To implement, test and develop intuition, intention and action are needed, while, to make this whole process possible, an atmosphere of trust and support is a prerequisite (Raami 2015).

Perception and Discernment Skills to Fine-Tune Intuiting

How can we recognize intuitive information in the first place? How are we able to receive multidimensional information? How can we develop sensitivity to notice more delicate and subtle signals? How are we able to discern the meaningful and important information out of the noise?

The skill of perception is needed in the recognition of signals and that of discernment in excluding the biases inherent in intuition. The development of these two skills usually leads to a more sensitive and precise ability to intuit.

Several studies from neuroscience and intuition research stress the importance of discerning between useful hunches and perceptions that can lead to beneficial intuiting and attaining valuable information (Bowden et al. 2005; Davis-Floyd and Davis 1997; Kautz 2005).

When we discern perceptions, and absorb information, we need to pay careful attention to the process. Intuitive information is the product of extremely rapid multidimensional information processing and sensations that are not always easy to understand or rationalize. Therefore, there is a risk to misinterpret them or to derive misleading conclusions out of them.

The situation can be illustrated with an example of another type of perception. When watching a mirage, the surface of the road is fluctuating, appearing to be covered with water. The heat waves are real, but in reality, the surface of the road does not move nor is it wet. The first part of the perception is real, but the conclusion derived is false.

Both our intuitive faculties and reasoning faculties are prone to biases. Therefore, we need to pay attention to how we construct and evaluate varying types of information in order to educate capacious thinkers.

Expanding the Boundaries of the Mind Opens up Possibilities

The rational mind can benefit from understanding that intuition is a precious part of the thinking process, which supports numerous everyday functions and can lead to superior outcomes in decision making and creating.

The foundation for unseen solutions and radical breakthroughs is rooted in openness of mind. Typically, human biology, physiology, physics and experience constrain what we consider plausible. However, prevailing, common beliefs are frequently overturned by new ideas, observations and scientific discoveries. Therefore, we cannot limit the search for solutions to the current understanding. If adopting a hypothetical '*what if*' or '*how might we*' attitude, the questions provide the mind a new cognitive frame, and intuition starts to work towards solutions. The mind begins to look for signals, clues, connections, patterns or useful perceptions for further evaluation.

Often, radical theories and odd perspectives lead to emotional resistance, cognitive perturbation or confrontation, but these are valuable and important signs of approaching the corners of one's mental compartmental boundaries. This is a natural and important phase of the process in which the old belief systems, often unknown to the person, are made visible hence they can be deconstructed or renewed.

Intention and Action Create a *Dynamo*

Intention and action form the core—the dynamo—of intentional intuiting. In practice, the actions can include, for example, attuning, implementing, practising, testing, developing, or sustaining. Intention can manifest, for example, in the form of interest, motivation, inspiration, concentration, focus, aspiration, patience, or the use of willpower.

While using intention and attuning intuition, it is necessary to be aware of the biasing effects of intuition. Emotional attachments like fears and wishful thinking can start biasing, narrowing or restricting the free flow of intuition, so it is beneficial to learn how these can be set aside (Raami 2015).

The model is dynamic in nature. The process of intuiting evolves and develops together with the individual. Perceptions, discernment and expanding the mind intertwine and feed each other. In practice, the process seems to cause a positive loop, where intuitive processing increases understanding about intuition, which then increases readiness to benefit from intuition more often. When paying attention to the process of intuiting, one can focus on any part of the figure. Even a short period of observing one's intuition including these components can help, but observing can be continued for years or even decades.

An Atmosphere of Trust and Support

Exceeding the limits of the known or nurturing unformed ideas requires both internal courage and an encouraging atmosphere. The most important role of a teacher or coach is to support and encourage because, as students attune to intuition, they are confronted with uncertainty.

The teacher needs to be somewhat familiar with their own intuitive process in order to share their personal understanding and experiences. The teacher has to expose themselves to the process of learning about themselves. Symbolically, the teacher needs enough courage to be able

to 'lean' towards labile situations and uncertainty. This allows new possibilities to emerge. In this setting, the teacher enhances and boosts the training process.

How Can We Evaluate the Reliability of Intuitive Information?

The last topic to be elaborated is discernment, which enables the ability to recognize reliable or biased intuitive information. Current intuition research offers some tools for better discernment.

In general, practice and trust appear to be crucial steps when interpreting intuitive signals and the reliability of intuition (Nadel 2006). However, feelings of correctness accompanying intuition are not necessarily a good measure of the accuracy of the intuition. Doubt also plays a significant role: any intuition, regardless of how strongly experienced and whether it is correct or not, can be swept aside by doubt.

Heuristics models suggest that intuition is so prone to systematic biases and errors that intuitions derived from it should be rationally analysed (Kahneman 2003; Plessner 2008). However, while heuristics biases are certainly undeniable, exposing intuition to constant rational judgement poses a paradox: rationally over-analyzing intuition has been shown to reduce the accuracy of intuitive judgements (Nordgren and Dijksterhuis 2009).

In practice, this paradox becomes a problem: a person cannot know when analysis becomes over-analysis, or when the situation leads to poor intuitive awareness through little or low-quality feedback (Hogarth 2001, 2008; Shefy and Sadler-Smith 2004).

However, the heuristics tradition is a useful reminder for the development of intuition. Heuristics are just one form of intuiting. If intuition is seen as a holistic, non-conscious representation matching process of past experiences, then proper feedback is critical to the development of intuition accuracy (Plessner 2008). Naturally, this evaluation cannot be carried out on all types of intuition, which makes such evaluation of accuracy challenging (Piatelli-Palmarini 1994).

In an optimal situation, a person has enough courage and trust for intuitive experiences to arise and to be attentively sensed. The best way to evaluate reliability of intuition is simply testing in practice; reliability can be can be analyzed to a sufficient degree, while respecting the

meaningfulness of such experiences. Further, studies of highly intuitive individuals reveal that they have developed personal and innate methods for evaluating the reliability of intuitive information (Davis-Floyd and Davis 1997; Kautz 2005; Mayer 2008; Targ 2004, 2012).

Confirmations and Biases of Intuitive Information

Based on literature and my research with designers, some individuals who regularly and successfully benefit from intuitive information have developed personal ways to evaluate the reliability of their intuitive signals. They report becoming aware of special signals or sensations, which work as confirmations for them. They work as a form of guidance, underlining the importance or the correctness of their intuition, or revealing the biases. These confirmations are personal and significant to their owners; the sensitivity to recognize them has developed over many years of reflection (Davis-Floyd and Davis 1997; Kautz 2005; Peirce 2013; Raami 2015).

When using confirmations as a tool for evaluating the reliability of intuition, a person needs to be able to interpret the signals instantly and correctly. This brings us to the moment of 'right after' presented earlier. Sometimes, the signal may be biased. Sometimes, it is too fast and observation too slow. Sometimes, noise overpowers the clarity of the signal. Sometimes, there is misinterpretation of a signal. With every type of signal, there are biases, which should be excluded to get a reliable confirmation.

Some of the confirmations can be 'stronger' or have more emphasis than others. However, if they are absent, it is not necessarily proof of an incorrect or false intuition. When a person is familiar with their process of intuiting, they often get confirmations of some kind. Even design students who are not very aware of their process of intuiting report these confirmations. Usually, a person can sense the signal through one personally typical source or sense, for example, goose bumps (Raami 2015).

Typical physical confirmations are for example sensations like '*gut feelings*' or '*cold shivers*.' With physical sensations, the usual bias is the misinterpretation of signals, for example, confusing the ordinary physical bodily sensations with intuition.

Some individuals get certain feelings or emotions like '*vibes*' or '*resonance*.' Highly intuitive individuals constantly report that with reliable intuition, all emotions are excluded. These may be fears, wishes, hopes,

attractions, desires, impulses, disgust, exclusion or ignorance. Intuition can be easily biased by emotional attachments.

Several individuals report mental signals like '*seeing*', '*visioning*' or an '*insight flashed*.' The most common bias associated with mental sensations is probably confusion with imagination. Many scholars state that there is a fundamental difference between intuition and imagination, insight, instinct or memory. Typically, imagination manipulates, edits and analyses, whereas instincts are inbuilt evolutionary reactions related to surviving (Davis-Floyd and Davis 1997; Kautz 2005; Shefy and Sadler-Smith 2004). These can benefit creative thinking and complex problem solving. However, it is highly beneficial to be able to discern the differences between them.

Occasionally, the confirmations are extraordinary by nature: an individual may see '*twinkling sparks of light*' or feel that something is '*integrated*,' '*immersed*,' '*illuminated*,' or '*connected*.' These types of signals are often reported along with scientific discoveries.

In highly personal sensing, the signal may be biased by misinterpretation, or it may be disturbed with obscureness that may label, colour or bias intuitive mental images, impressions or sensations. If a person's mind is very strong, it may start to create a belief, which of course may help create the mental images that assist invention. However, creating by belief and intuiting are different mental operations as well.

The variety of confirmation and biases underline the importance of self-knowledge. For sceptics, it would be tempting to claim that all these confirmations are biased through creating by belief, but according to the experiences reported by designers and highly intuitive persons, this is not the case. With the aid of these confirmations and biases, many people seem to be able to recognize reliable intuition, with accuracy and reliability. However, according to many references, the intuitive process evolves. It renews and changes along with the person using it. Therefore, internal alertness should be habitual.

Towards a Working Method of Intuition

The issues presented above unfold some aspects of the human mind, possibilities of knowing and personal experiences of intuiting related to problem solving and creative work. These may bring new insights for teaching and learning.

Decision-making is an individual act; therefore, the perspective and capacities of a single individual are extremely important, as stated above, because coherent decision-making is the key to sustainable wellbeing. Sustainable choices made through better decisions will improve the coherence of natural and social systems.

However, many educational structures are outdated, rigid and conflicted by many competing agendas. Hence, it is not straightforward to introduce new ways of thinking and doing into this ossified context. It does not help that current attitudes inside and outside of education systems tend to favour competition, measuring, exclusiveness, segregation and ranking, which are values based on dissociation and self-interest. Among the many problems this creates, one is that it can assign a negative value to an individual, effectively removing them from 'productive' society. But perhaps through greater recognition of the value and utility of intuitive and creative processes, the full potential of every learner can be realized. This is especially true for today's students who face disquieting uncertainty about the future.

Changing attitudes and unlearning limiting mental structures, or implementing something radically new takes time. This is true even in the academic world that largely operates in siloes leaving gaps between domains. Knowledge is constructed in canon: new knowledge is developed mostly with like-minded colleagues. In the worst case, this leads to unilateral and stagnant viewpoints where transgressive or second order research is not initiated and decision-making is based on avoiding mistakes with respect to a single disciplinary silo.

Complex, wicked problems cannot be solved with single domain expertise and a rigid mindset. How can we form new, shared knowledge structures that generate societal impacts and sustainable future? And how can we bridge the old educational system into a new one and construct a transition pathway? We need our intention and thoughts aligned towards finding new ways to initiate change on multiple levels: changes in single individuals, structures and systems.

Summary

Decision-making, complex problem solving and radical innovating are cornerstones of a coherent and sustainable future. To be able to surpass the challenges the world is facing, we need to search new dimensions of

understanding for problem solving and innovation. To be able to solve the impossible problems requires exceeding the limits of the known.

The current scientific paradigm, beliefs and physical constraints narrow our thinking to what can be considered plausible in the first place. What we currently know, defines the question framing and problem scoping, hence narrowing the solution space. We ignore potential solutions we consider impossible.

However, it is possible to surpass ingrained understanding. There is still vast, untapped potential of the human mind. People who benefit from intuiting and resilient thinking create advances and innovation compared with analytical thinkers. Further, intentional intuiting can assist achieving new dimensions of knowing, inventing and creating. To enable this, it is indispensable to educate the mind to be less resistant and more accepting toward the unknown, uncertain and ambiguous.

This highlights the importance of self-knowledge skills and abilities to leverage internal knowledge beyond what is consciously known. Luckily, most of the skills related to internal knowing are trainable. Smart intuition can be integrated with sharp reasoning and education.

But this is not enough. We also need to create and exploit shared and intelligent knowledge structures to integrate wisdom from different fields of knowledge. In addition, an important step to be taken is the one you can take at this very moment. That is, consider that all of society's wicked problems are indeed solvable. It begins by understanding that it is *possible*.

Note

1. *Noetic* originates from the Greek word *noēsis/noētikos*, meaning inner wisdom, direct knowing, or subjective understanding ("IONS, Institute of Noetic Sciences" 2014).

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