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4. WE MUST PREPARE FOR THE UNFORESEEABLE FUTURE

The featured chapter of this volume makes the highly-tenable claim that a large number of new challenges and problems have arisen in the 21st century. The featured chapter immediately connects these new problems to new opportunities. It describes what is required to solve the problems and take advantage of the opportunities (i.e., knowledge, skills, and dispositions) and explores implications for education in the 21st century. The featured chapter, by Ambrose (chapter 2, this volume), refers to the challenges of the 21st century as *macroproblems*. This is an apt label. Many of the problems he mentions are new and unique to the 21st century, and many are so broadly encompassing that, one way or another, they threaten a broad spectrum of society.

The new problems faced in the 21st century are not just technological, scientific, medical, economic, political, and ecological. They are also moral challenges, some of which are the direct result of the advances within technology, scientific discovery, medical innovation, and so on. The connection between technology, science, medicine, and these other areas with morality has led to a shift within the creativity research. This shift and the particular moral challenges arising in the 21st century were foreshadowed in a special issue of the *Creativity Research Journal*, devoted to "Creativity in the Moral Domain" (edited by Gruber & Wallace, 1993). One conclusion from that work was that creative problem solving will be required to solve the moral dilemmae, many of which are related to various macroproblems.

The present chapter explores the creative problem solving process and extends the thinking proposed by Ambrose in the featured chapter. The creative process described herein will facilitate a *shift of perspectives* that will in turn allow what may first appear to be problems to be interpreted as opportunities. This kind of shift of perspective has been described previously in the research on *problem finding* (see chapters in Runco's 1994 edited volume on the topic). The present effort summarizes the research on problem finding and argues that it depends on a universal creative capacity and in particular on the construction of novel interpretations. The present chapter also connects immersion, engagement, intrinsic motivation, adaptation, persistence, decision making, and perception to the creative process. These should each be targeted in the educational system with a likelihood of beneficial returns for the 21st Century.

D. Ambrose & R. J. Sternberg (Eds.), Creative Intelligence in the 21st Century, 65–73.

THE DISAPPEARANCE OF THE PROBLEM

The title of this chapter was adapted from Bruner's (1962) essay on creativity. In that essay Bruner argued quite convincingly that the primary objective for education was to "prepare students for the unforeseeable future." Those words are even more compelling today than they were when Bruner penned them. That is because the acceleration of cultural evolution is such that change is occurring faster and faster. Sociocultural changes are most accurately viewed as reflecting Lamarckian evolution, which is much faster than Darwinian revolution. Lamarckian evolution applies to changes that, once introduced, remain a part of culture from that point forward. This is especially obvious with technology. Once a computer processor is invented, for example, we have it forever. It immediately becomes a part of culture and need not be rediscovered or reinvented at a later date.

The problems and challenges of the 21st century are also imposed on us at an ever-increasing rate. In this sense, we not only have new 21st-century problems; we have a whole new social and technological context. It is in fact the acceleration of change that makes the future unforeseeable. And because the problems and opportunities are both different from previous experience, educators cannot merely provide students with skills that work in today's society. Many of today's jobs will disappear. Many skills used today will be useless quite soon. One of the few things that will help students in the unforeseeable future is creative skill.

One creative skill with clear relevance to the unforeseeable future is implied by the title of this particular section of the present chapter, "The Disappearance of the Problem." This is also a quotation from an earlier essay, namely that of Wittgenstein (1921/1974, p. 73). It is quoted here because the idea of disappearing problems is enormously useful for pinpointing how creative thinking will allow problems to be transformed into challenges and opportunities. Wittgenstein's idea may sound a bit magical—one, two, three, the problem is gone!—but in actuality there is a rationale for what he describes as disappearance in several lines of psychological research. One line of research is biographical. It contains illustrations of how famous creators became totally immersed in their work or in some problem. In some cases a problem became the focus of their thinking, day in and day out. Such intense engagement is apparent in the lives of Darwin and Einstein (Gruber, 1981; Miller, 1992), just to mention two luminaries.

Then there is the work on gifted children and prodigies who develop expertise because they are, as Howard Gruber once put it, "on fire" to learn about and engage in their chosen field. Gruber (1985) described a chess prodigy who would play his game 6, 8, or more hours each day, if allowed to do so—and he was only 8 years old! Certainly chess is a game and not, say, hard physical labor, but many 8 year old children cannot devote themselves to something that requires sitting in one place and concentrating on one small location (i.e., a chess board) for hours and hours, day in and day out. Yet if the child is "on fire" and so deeply engaged, there is an immersion that is similar to that of the famous adult creators.

Some of the support for the idea of problems disappearing is experimental. The research on intrinsic motivation has, for example, demonstrated that there is often a cost to being dependent on consequences, contingencies, and other extrinsic reward, at least in terms of creative thinking. Intrinsically motivated behavior is more often associated with creative thinking and creative achievement than is extrinsic thinking. And it is easy to see why this would be the case. An intrinsically motivated individual is likely to care more about the task itself and will be less concerned with the consequences of his or her work. The intrinsically-motivated individual is also able to concentrate more easily because outside distractions (e.g., supervisors or contingencies) are diminished. Then there is the likelihood that the intrinsically-motivated person will persist, which in turn increases the probability of finding remote associations and original ideas and solutions. There are many instances where creative performance has resulted from extrinsically motivated behavior—think of commercial art, for example—and to be realistic both intrinsic and extrinsic motivation are relevant to the creative process (Rubenson & Runco, 1992; Runco, 1994). But intrinsically motivated behavior frequently facilitates creative behavior.

The immersion and engagement just described may play a large role in transforming problems to challenges. To understand how this transformation happens, it is useful to have a working definition of *problem.* Problems are defined in terms of objectives, or goals, and obstacles. If someone has an objective, but there is an obstacle in the way, that person has a problem. The creativity research categorizes problems in various ways (Houtz, Jambor, Cifone, & Lewis, 1989; Runco, 1994). Some are open-ended, some closed. Some require algorithmic thinking, and others can be solved heuristically. Problems may be structures such that a restructuring leads quickly to an insightful solution, while some must be approached incrementally. Some problems are presented or imposed on the individual; others are discovered. Regardless of the kind of problem, a problem implies that there is an obstacle to some objective.

What if the person is in what appears to be a problematical situation but is enjoying the process and would not remove the obstacle even if he or she could? What if the end result, a solution, is less important than the process, the work, the journey?

These questions might be best answered by again considering Wittgenstein's (1921/1974) philosophy. And indeed, Wittgenstein is more often quoted by philosophy textbooks than psychology textbooks. This tie to philosophy is relevant because individuals who are immersed in a challenge may very well have found a meaning in life. That certainly sounds like philosophy—the discovery of meaning—but it can be translated to a psychological process as well. Meaning in life can be defined as having a purpose, which in turn implies that one's work is intrinsically interesting. Recall here what was just said above about determination and persistence. "Purpose" may direct a person's work for decades and motivate continued effort (Gruber, 1996). Creative achievement sometimes results. Simonton (1994) reported that creative achievement can be predicted by three things: (a) starting in one's field at an early age, (b) regular, continuous effort within that field, and (c) longevity

within the field. The first of these may be a matter of luck, as is the case when the individual has a crystallizing experience (e.g., as a child Einstein was given a gift of a compass, and the Wright brothers as children received a gift of a toy flying machine), but certainly (b) and (c) reflect effort, decision-making, and motivation.

The effort and motivation follow naturally from the individual's engagement. Many decisions do as well, though these tend to be conscious and intentional. What decisions are made will gravitate towards what is important to the individual, so they too are tied to purpose and meaning. There are numerous decisions that can lead a person to creative behavior, including what ideas to take seriously, what education to pursue, how to allocate resources, and even where to live (Florida, 2004; Runco, Johnson, & Gaynor, 1997). On the topic of resources, recall Ambrose's (chapter 2, this volume) discussion of various macroproblems resulting from limited resources.

In fact it might be instructive to briefly explore a concrete example of creative thinking for the solving of a macroproblem. Ambrose (chapter 2, this volume) provided a good start and can be quoted to get us started:

> The BP oil disaster in the Gulf of Mexico foreshadowed another pressing macroproblem – a looming shortage of resources such as hydrocarbons, minerals, and arable land… Klare (2012) illustrated ways in which these shortages are encouraging extraction industries to take ever-bigger risks such as deep-water drilling and mining in dangerous regions because easily accessible resources are disappearing quickly. …These extractive processes are far more damaging to the environment than conventional oil and natural gas extraction, and those processes were dirty enough. Consequently, the energy industry is causing far more devastating environmental damage than ever before, and this damage includes the rapid acceleration of climate change… The potential for dangerous international conflicts over territory and resources also is rising due to the shortages… In addition, wealthy nations such as Saudi Arabia and the United Arab Emirates are buying up enormous tracts of arable land in third-world countries in order to ensure their own food supplies at the expense of the impoverished populations in those nations. International tensions are rising over this practice. In the long run, we must either use our ingenuity to come up with replacements for some of these resources or pay gargantuan ethical and economic prices for them in the future.

Creative thinking is needed, and quickly. More specifically, those involved need to shift their perspectives and redefine the situation. The solution is not to continue along the present course. What is needed is a shift towards alternative forms of energy and towards an evaluation of how energy is being used. Very likely, corporations and nations will find opportunities, financial and otherwise, if they invest in alternative forms of energy instead of simply trying to move faster in the same direction. Paraphrasing Klare (2012), instead of "racing for what is left," the opportunity to innovate while conserving should be exploited.

TRANSFORMATIONAL CAPACITY

This chapter proposes that the problems of the 21st century can be solved with creative problem solving. So far decision-making, problem definition, and intrinsic motivation have been brought into the creative problem solving process. This process can lead to a shift of perspectives such that problems become opportunities. Problems can also be *transformed* such that they are opportunities. It is indeed quite beneficial to consider the creative problem solving process in terms of cognitive transformation, interpretation and the universal creative capacity.

The problems of the 21st century will not disappear but there is reason to believe that they can be transformed such that solutions are more likely. This process, from problem to engagement to creative solution – requires creative skill. It might be best to use the label *creative capacity*. That is because the process is not something rare or exceptional. It is an inborn and universal capacity, no doubt a result of our evolutionary history. It has given us an enormous evolutionary advantage (Albert, 2012). This capacity is used by each of us, and sometimes several times each day. It is, then, readily available, though it requires support and direction. Fortunately Ambrose (chapter 2, this volume) and others (e.g., Cropley, 1992; Fasko, 2001; Runco, 2003) offer methods that can be integrated into the educational system for exactly this purpose. The *ingenuity gap* highlighted by Ambrose might be circumvented if the creative capacity is fully utilized. Another way of saying this: Creative potentials unfulfilled will lead to a large ingenuity gap, but the fulfillment of creative potentials will minimize or eliminate the gap. Not everyone sees creativity as a universal and daily process. This is a theory of Big C creativity, for example, that focuses on original achievements that change the world or at least have enormous impact (Merrotsy, 2013). The theory of Big C creativity does assume a little c creativity as well, but little c creativity is supposedly entirely personal and mundane. Elsewhere I have suggested that the Big C/ little c dichotomy be avoided precisely because it separates the widely-distributed creative capacity from wide-impact creative achievement. The dichotomy is especially problematic if the intent is to support and encourage creativity such that creative potential be fulfilled and personal creativity be engaged such that it is directed towards macroproblems. This is one way to describe an ideal for education, as the fulfillment of creative potentials such that universally-shared creative capacities are brought to the solution of macroproblems, be they technological, cultural, political, environmental, or economic.

It is easy to see creative capacities as universal if they are tied to the processes mentioned earlier in this chapter, and in particular if they are tied to the possibility of creating meaning. That is a universal need, to find meaning in life (May, 1994; Richards, 2007; Runco, 2007), and it requires particular interpretations. After all, life *will* present problems. There will be challenges, disappointments, struggles. There is no way around them, though their particularities will vary from person to person (other than death and taxes). Thus the only option for meaning is to interpret what

life presents in a creative fashion. Fortunately, we inherited the capacity for doing exactly that—constructing creative interpretations. This capacity can be viewed as that which allows the construction of interpretations, though theories of top-down processing can be cited as well, as can the idea of cognitive transformations.

Consider for a moment the experience of psychological stress. This occurs when there is a failure to adapt. The environment imposes a challenge, and if the individual does not adapt, he or she experiences stress. The psychological experience is not "out there," however. It may be triggered by some objective experience, sometimes called a stressor, but in actuality the stress is a subjective interpretation of the experience. That is why two people can have the same experience and one reacts with stress while the other does not react or reacts very differently. If stress were a function of the objective experience, those two individuals would have the same reaction. Stress is not demanded of us. It is our interpretation of certain experiences.

Interpretation can also be understood by contrasting it with *sensation*. Sensation involves the mere detection of information. One of the five sensory modalities responds to energy or other information in the environment; the nerves in the cochlea respond to particular frequencies of sound, for example, or the rods and cones respond to particular wavelengths of light. This information is conveyed to the nervous system, but the individual is not yet aware. The nervous system is reacting, as it evolved to do, but meaning has yet to be assigned. We could not possibly assign meaning to everything being processed on a sensory level. Instead our cognitive systems select what is important, attention is allocated, and meaning can be found. Using the vernacular, our sensory systems allow information to enter the cognitive system, but perception only occurs some of the time—only when the information is interpreted such that meaning is constructed.

Much of this should sound very familiar. The description of stress, for example, involves the same argument used earlier in this chapter when describing the disappearance of problems. Both stress and the negativity of problems come down to interpretation. This may also sound familiar to students of Jean Piaget's (1976) developmental theory. Piaget described how the cognitive structures that allow understanding are actively constructed as the individual processes new experiences. For Piaget this involved adaptation, and more specifically *assimilation* and *accommodation*. Other processes have been identified and named to explain the construction of understandings, but the key point is simply that understanding is constructed. It is, put most simply, created by the individual. The construction of understanding allows equilibrium whereby the individual is able to cope with an ever-changing environment. The fact that our world is changing at a faster and faster pace makes adaptation that much more important, which in turn means that the creative capacity that is required for the construction of understandings is also increasingly important. The universality of this kind of creativity is indicated by the fact that we are each capable of developing new understandings. Each of us can interpret experience as stressful, or not, as problematic—or as challenging, engaging,

and meaningful. As a matter of fact Piaget (1976) can again be cited because he argued that adaptation is biologically-based and intrinsically motivated.

A handful of theories of the creative process have emphasized transformation as a key component of creative problem solving (Guilford, 1968; Feldman, 1978), and one recent investigation took an initial step towards measuring creative transformation. In it Catalana and Runco (2014) administered several new measures. One was a figural test of divergent thinking that was presented along with directions for examinees to think of as many things as they could for what the figure could represent. Three figures were presented, one at a time. The examinees were then given explicit instructions with figures that asked them to think of things that were represented but to utilize certain tactics, including turning the figure upside down, or imagining it smaller or larger. The idea here was that individuals with strong transformational skills would have a significantly different number of ideas, and perhaps a significantly different number of original ideas, when given the explicit instructions. If so, the conclusion could be drawn that the explicit instructions elicited or facilitated cognitive transformations of the figures. A second measure in this same study also employed divergent thinking tasks, but verbal and not figural ones. It asked the examines to generate problems. This kind of problem generation task has been used before with good reliability, but Catalana and Runco followed it up with a question asking the same examinees to look back on their own problems, selecting one, and reinterpreting it as an opportunity rather than a problem. The logic for this task is no doubt obvious, given what was said earlier in this chapter: problems might be transformed and re-interpreted such that they are not negative difficulties but opportunities instead. Tentative analyses demonstrated that both the figural and the verbal measures were reliable. Additional analyses are underway to determine if the transformation tasks also have predictive power. This set of analyses uses various criteria of creative performance. If the measures prove themselves to be psychometrically sound, future research might employ them such that educational efforts designed to encourage the skills outlined herein are accurately evaluated.

CONCLUSIONS

It would be nice if problems really did disappear. They may never do so, however, but the next best thing is make the best of the situation and reinterpret to take stock of potential opportunities. Educational efforts should prepare students for the unforeseeable future by acknowledging the difficulties of the 21st century and by supporting creative capacities such that macroproblems, though broad and global, are meaningful and engaging. The thesis of the present chapter is that creative capacities involve interpretative and transformational skills, and that these can be targeted in education, and that this is the best way to prepare students for the unforeseeable future. Educators should be pleased with the creative process outlined in this chapter, especially in that it described intrinsic motivation and engagement

as byproducts. A student will be motivated if the educational context challenges in a personally meaningful way. Educators need not target motivation. If they create the right context, natural motives will energize students (Piaget, 1976; Runco, 2003).

The creative capacity outlined here defines creativity in a particular fashion, but very significantly, the definition of creativity assumed here is entirely consistent with creativity as defined more broadly in the social and behavioral sciences. Runco and Jaeger (2012) reviewed definitions of creativity, asking who might have been the first to propose (a) originality and (b) effectiveness as the requirements. This is the "standard definition of creativity." The exact terminology varies slightly, with originality sometimes called *novelty* or *unconventionality* and effectiveness sometimes called *fit*, *appropriateness*, or *usefulness*, but virtually all contemporary research involves originality and effectiveness in some guise. That is not to say that the standard definition is entirely adequate. There are concerns. Simonton (1994) added surprise to the definition, and Kharkhurin (2014) and Tan (in press) questioned the cross-cultural applicability of the standard definition. Khurkhurin felt that *authenticity* should be added in order to understand creativity as it usually appears in Eastern cultures. Tan's view is especially germane to the argument here in that she described the creativity of Confucius as a matter of morality and self-enlightenment. This led her to the same conclusion presented just above, namely that meaning is a result of the creative process and is itself a creative product.

One of the most important ideas presented in this chapter is that of decision making and the related idea of an allocation of resources. This allocation was only mentioned in the discussion of attention, but attention is not the only limited resource that plays a role in creative efforts. Ambrose (chapter 2, this volume) and Rubenson and Runco (1992) identified other critical resources, some interpersonal, some intrapersonal, and Sternberg (1997) went into some detail about the practical intelligence that allows entrepreneurs and other creative individuals to make decisions that lead to creative action and achievement. The need for particular decisions and an appropriate allocation of resources is being underscored here because these are things that can be discussed and explored in education. Students can be encouraged to make decisions that will lead to their investing in creative options and in alternatives that are meaningful, both personally and more broadly, to society as a whole.

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