

## Chapter 2

# Interdisciplinary Research as a Creative Design Process

Rick Szostak

**Abstract** Lessons are drawn from the literature on creative design for the interdisciplinary research process. It is argued that the interdisciplinary research process is a creative design process. It follows a similar set of steps and can/should employ many of the same strategies. Both processes are thought to blend conscious and subconscious thinking. Interdisciplinary researchers who aspire to be more creative, and interdisciplinary instructors wishing to encourage creativity among students, are given advice on how to integrate creative practices into various steps in the interdisciplinary research process. Potential psychological, institutional, and skill-based barriers to creativity are addressed. Several strategies are outlined that are conducive to creativity in the early conscious information gathering/evaluation steps of the interdisciplinary research process. The costs and benefits of such strategies are discussed. Quite different strategies for encouraging creative subconscious integration of the information collected are then outlined. These integrative insights must then be consciously evaluated: It is important not to expect perfection but not to ignore potential side-effects. Perhaps most importantly it is argued that persuading others of the value of one's comprehensive understanding is a critical component of the interdisciplinary research process, and that this step also requires the blending of conscious and subconscious processes.

**Keywords** Creativity • Design • Interdisciplinarity • Subconscious Persuasion • Interdisciplinary research process

## Introduction

The literature on the interdisciplinary research process (IRP; see Repko & Szostak, 2016; Bergmann et al., 2012; Association for Interdisciplinary Studies (AIS), 2013) seeks to identify useful strategies for performing various steps in interdisciplinary

---

R. Szostak (✉)

Department of Economics, Faculty of Arts, University of Alberta, Edmonton, AB, Canada  
e-mail: rszostak@ualberta.ca

research. It recognizes that interdisciplinary research—and especially the critical steps of *creating* common ground and integrating insights—is inherently creative. The interdisciplinary researcher is urged to combine conscious and subconscious thought processes in creating an integrative understanding.

The literature on interdisciplinary research has drawn on a number of related literatures: on common ground theory from psychology, on the science of teams in sociology, on learning and cognition, and many others. But the creative aspects of interdisciplinary research have seen less attention than the more logical and conscious elements of the research process. The purpose of this chapter, then, is to explore whether the literature on creative design (and the separate literatures on creativity and design on which this builds) can be drawn upon to suggest useful strategies for interdisciplinary researchers. The chapter itself then is integrative: It connects these distinct literatures in a way that adds to what we already know about how best to pursue interdisciplinary research. It thus responds belatedly to Klein's (1990) call for «exploring the connections among creativity, problem solving, and the interdisciplinary process» (p. 196).

The chapter first defines creativity and explores how the interdisciplinary research process compares to processes outlined in the literatures on both creativity and design. It then surveys how various steps in the interdisciplinary research process might be adjusted in order to encourage creativity among both researchers and students.

## Defining Creativity

Creativity is generally defined in terms of both novelty and utility. For an idea or object to be creative in a social sense, it must also be communicated and judged to be appealing. In some fields, additional elements such as elegance may be added to the definition of creativity. Notably, since there can be degrees of novelty, usefulness, and elegance, we can also speak of degrees of creativity: Some acts are more creative than others (Simonton, 2013). In many fields, creativity is seen to involve the combination of previously unconnected ideas. Though it may seem that scientific creativity is different from other types of creativity, Spooner, (2004), following Dunbar recognizes that «most researchers see scientific creativity as being composed of the same mental processes that guide all other forms of creativity» (1999, p. 525). Interdisciplinary creativity might then be defined as a novel and useful solution to a question or problem, which generally involves drawing connections among previously disparate ideas.

## The Creative Process and the IRP

The interdisciplinary research process has several steps: asking a suitable research question, gathering insights from relevant disciplines and evaluating these, mapping interdisciplinary linkages, creating common ground among these insights,

integrating disciplinary insights, developing a more comprehensive insight, and then testing, reflecting and communicating (Repko & Szostak, 2016). The first and last steps of this process are generally thought to be rational, conscious activities, while the steps in the middle associated with creating common ground and integrating draw much more heavily on the subconscious.

It cannot be stressed too much that the literatures on both creativity and design also envision multi-step processes where subconscious activities are concentrated in the middle (we shall find below that there is scope for creativity also in persuading others toward the end of the process, and recommend this to interdisciplinarians as well). With respect to creativity, a four-step process outlined by Wallas in 1926—preparation, incubation, illumination, and verification—infuses most/all more recent models of creative processes (Spooner, 2004). Wong and Siu (2012) agree that the various creative processes outlined in the literature are broadly similar. Linkner (2011), for example, has five steps: ask, prepare, discover, ignite, and launch. *The Hermann Brain Dominance Instrument* (Herrmann, 1992) also has five steps, with different parts of the brain involved in each: interest, preparation, incubation, illumination, and application. Herrmann associates each step with quite different mental processes: For example, Illumination is associated with theta waves, the kind that accompanies meditation or waking up, whereas preparation and verification involve beta waves.

The literature on the design process typically suggests four steps: problem identification, analysis, synthesis, and evaluation. Again, the conscious mind dominates the first and last steps, while the subconscious is critical for the third. Naturally, some versions are more complicated, with additional steps. But the same progression from identifying a problem through gathering and evaluating information to creating something new and then examining this creation is pursued. Mumford, Giorgini, Gibson, and Mecca (2013) thus develop a model that consists of eight steps: problem definition, information gathering, information organization, conceptual combination, idea generation, idea evaluation, implementation planning, and solution monitoring. Though the terminologies used are different, the processes imagined in the three fields are obviously quite similar.

The literatures on creativity, design, and integration concur in a further important respect: They all recognize the importance of iteration, that is, revisiting earlier steps as one proceeds. The literatures on creativity and design differ from the IRP, though in stressing how one creative process feeds into another. The IRP literature has tended to treat individual research processes in isolation (albeit appreciating that they are internally iterative) and could usefully reflect on how one research project might set the stage for others.

The literatures on creativity and design also agree that teachers and students should be aware of the multi-step processes involved; though Doppelt (2009) warns that students should not follow this slavishly. Advocates of the IRP still struggle against a widespread belief that interdisciplinary research is something one can do without consciously pursuing an interdisciplinary research process.

Pasteur (1854/1937, p. 131) warned us over a century ago that creative insights come only to the prepared mind. The literatures on creativity and design discuss in

some detail how one can set the stage for creativity while one is gathering relevant information (see also Welch, 2007). The next sections of this chapter draw lessons for the first steps of the IRP.

## Asking a Question

The IRP begins with several guidelines for identifying a good interdisciplinary research question: It should be clear, jargon-free, manageable, and beyond the capability of any one discipline to address. The literature on creativity suggests further considerations. And Sill (1996), following others, warns us that:

The most important part of the creative process may not be the creative product, which in the case of integrative thinking is the integrated thought itself, but rather may well be the framing, discovery, or envisioning of the creative question. (1996, p. 125)

Recall that there are degrees of creativity. If we ask a question of the type “How does A affect B?”, we limit the potential for creativity far more than if we ask “How might we alter B?”. The second question encourages us to identify novel connections. The first question is, however, much more manageable. An undergraduate with severe time constraints may wish to emphasize manageability, but should appreciate the cost. A scholar wishing to solve/alleviate an intractable problem or gain a reputation may instead prefer to lean toward creativity. The advice then is to word the question in such a way that does not guide one to pursue a narrow range of answers. A creativity-encouraging question is one for which even the broad outline of the answer is not obvious. But questions can be too broad also: “How to make the world better?” may give the subconscious mind no traction. The creativity-enhancing question should at least give us some idea of where to look for relevant information. As we gather information we may develop a more focused question, but not so focused that it eliminates opportunities for creativity.

Scholars of creativity, like scholars of the IRP, appreciate the advantage of a problem-based focus (Doppelt, 2009; Sill, 1996). Sill (1996) suggests that the first step to creativity is asking “What is the real problem?” which invites placing what appears to be the problem in a broader context. For example, understanding why some groups of students are underperforming in school may require looking far beyond the school for answers.

Linkner (2011) advises us to look ahead to the very end of the process. As we shall see, one key aspect of creativity is convincing others that our idea is useful. Linkner thus urges us to reflect not only on the problem itself but on the barriers to its solution, the audience we will need to convince, and the communication techniques we envision. The point here is that there is little value in developing ideas that will never be utilized. But Linkner does not want to discourage us from acting but rather to focus our efforts on developing ideas that we think we can “sell.” This may require even greater creativity than simply addressing the problem. Linkner finds it useful both at the start and throughout the creative process to ask not just

“Why?” but also “What if?” and “Why not?”. Klein, in this volume (Chap. 4), likewise recommends continued reflection on the question: “Transdisciplinary process is not simply a matter of bringing disciplines to a problem. It entails continually learning what the problem is through critical reflection” (p. 64).

Researchers wishing to pursue creativity, then, should frame their question in a way that guides research but does not constrain answers, grapples with the true nature of the problem at hand, and reflects the environment in which any creative insight will need to be adopted.

## **Identifying Relevant Disciplines, Theories, Methods, and Phenomena**

One element of creativity deserves emphasis here: Creative solutions are to at least some extent “surprising.” The ideas that are the most surprising—but also useful—will generally be judged the most creative. There is an important trade-off here, then, between looking where relevant information is most likely and looking where surprising connections are most likely. The advice we give to students—to identify the most relevant disciplines to their research question—is surely valid. But more advanced scholars should recognize that they are more likely to make a surprising connection by looking in less obvious places. A discipline with only a tangential interest in the problem at hand may hold a critical insight into its solution. Moreover, the greater the range of insights—and thus combinations—that one identifies, the more likely one is to be creative (Wong & Siu, 2012).

How do you identify possible surprises? One strategy involves brainstorming the broader context of the problem. One should start out by being open to seemingly crazy ideas. Those ideas that seem like they might have some merit may guide researchers to look in disciplines that would otherwise escape their attention. Brainstorming can thus be contrasted with a more rational identification of the most likely influences.

## **Literature Search**

It should be noted that our present state of “information overload” can itself be a barrier to creativity. McGuinness (2011) worries that some shy away from searching for relevant information because of a sense that there is simply too much. Yet there are at least three distinct literatures in the field of information science—literature-based discovery, undiscovered public knowledge, and serendipity—that each recognize that important scholarly discoveries often come from juxtaposing distinct ideas from different scholarly fields. Szostak, Gnoli, and López-Huertas (2016) discuss how systems of knowledge organization could be changed in order to enhance such juxtapositions in particular and interdisciplinary research more

generally; they also provide much insight along the way into the structure of existing systems and how these might be navigated. The interdisciplinary researcher should appreciate that locating the right set of literature—that is connected but in a way that nobody has appreciated—is an important source of creative insights. They should also appreciate that our present systems of library classification do not make it easy to locate distinct but related literatures. The researcher thus needs to reflect deeply on just what sorts of related information might be useful and where they might be hiding.

## Evaluating Insights

The IRP provides several strategies for evaluating disciplinary insights—the conclusions generated in disciplinary research—before these can be integrated into a novel and more comprehensive understanding. The strategy with the greatest implication for creativity involves asking of each insight what is left out: What variables, theories, or methods addressed by other disciplines were excluded from view as this insight was developed? (Note that we capture here elements of “What if?” and “Why not?”). Such a strategy guides the researcher to identify connections that are missed in the existing literature.

Again we face a trade-off. We might identify a variable studied by sociologists that fairly obviously deserves attention in a theory posited by economists. We might identify other phenomena whose importance is less obvious. We can make a useful contribution to scholarly understanding by focusing only on the first type of omission—and a contribution that is novel and useful and thus creative. But we may be able to produce a far more creative insight if we reflect a bit more on those phenomena whose importance is less obvious. We are trying to give our subconscious processes a range of possibilities to play with and should be careful not to exclude possibilities that our subconscious may find useful. Creativity necessarily embraces complexity.

Repko and Szostak (2016) provide tables of phenomena studied in various disciplines, types of theories applied, and methods applied. These tables are generally employed in a very conscious process of identifying the most relevant phenomena, theories, and methods. Their role in stimulating creativity deserves also to be highlighted: They potentially provide the subconscious with a broad set of possible connections. The goal for the creative researcher, then, is to look through such tables not just for the obviously relevant items but the “just might be relevant” items. Some may imagine a conflict between the structure of detailed and fairly exhaustive classification and the freedom associated with creativity, but structure can set the stage for novelty.

Note that we do not throw away an insight simply because it has limitations. Rather we ask if other insights can perhaps address these limitations. Again this process will sometimes be straightforward. At other times it will be less obvious how a limitation can be addressed. This situation also becomes grist for our

subconscious. In engineering, the Pugh Method involves employing creative thinking to suggest how flaws in various designs might be addressed in order to identify the optimal design. Engineers, it might be noted, do not seek perfection, but recognize that there will be imperfections in any design. In interdisciplinarity, as in design, we need to embrace the idea of ever-better solutions to challenges as we build on previous understandings.

Last but not least, we should be open to surprises. When we encounter a piece of information that is surprising we should carefully examine why this is so. SuperGlue was discovered by accident while researchers were pursuing a quite different project. Many on the research team saw this unexpected stickiness as a problem, but their supervisor recognized that they had a solution to a quite different problem (a recognition, it might be noted, fueled by a breadth of interest and knowledge). We should be willing to let surprises carry us in new directions. In the case of SuperGlue, an entirely new research question was generated (Darbellay, Moody, Sedooka, & Steffen, 2014). Surprises are a regular feature of research and have historically triggered many creative acts (Darbellay et al. mention also Post-it notes, Viagra, and Velcro), but we need to consciously (or subconsciously; see below) appreciate their importance.

## Mapping

The IRP recommends visually mapping the connections among phenomena that appear relevant to the research question. This exercise aids the researcher in clarifying insights and in identifying connections not only among phenomena but among disciplines, theories, and methods. Such an exercise in visualization likely also encourages creativity. Creative insights generally *emerge* in the form of imagery: We picture our creative solution in some way (Spooner, 2004), likely because our subconscious operates sublingually. Images are still important as our conscious mind develops the creative insight: «We have re-defined design as being the process of composing a desirable figure toward the future» (Taura & Nagai, 2010, p. 8). If we accept that creative insights are generally visual (and always abstract and symbolic), then it makes sense to prepare our mind visually to achieve these.

How detailed should we get in our mapping? Yet again there is a trade-off between including only those phenomena that seem of great importance to the problem at hand versus attempting a much broader coverage. The literature on engineering design suggests a fairly broad coverage so that potential side-effects of a design are more readily appreciated.

Buzan (2010) has studied creative thinkers across many societies. He recommends a process called mind mapping, where the focal question/problem is placed in the middle of a piece of paper and connections are made to main ideas and thence to subsidiary ideas. Buzan's mind map is similar to the maps recommended in the IRP—though the concepts placed on it need not be variables: We could thus add the theories and methods identified above, and any concepts uncovered in our research.

But his purpose is different: to fire the imagination. Given that creative ideas are (generally) combinations of previous but unconnected ideas, if we place a set of relevant ideas on a piece of paper and then “free-think” about possible connections among them, we greatly enhance the possibility of a creative breakthrough. Buzan recommends using different colors or symbols to identify connections. Even on the sort of map currently recommended in the IRP one could usefully contemplate connections among variables not seemingly related. But Buzan urges us toward a “messier” map where we place every seemingly relevant idea on the same piece of paper, let our subconscious view the whole, and set the stage for the discovery of novel connections.

Mind mapping is intended as an exercise that links conscious and subconscious processes. Studies have shown that multiple parts of the brain are working when contemplating a mind map. The mind consciously identifies the concepts that are placed on the paper. The subconscious then takes them in as a whole and can imagine novel connections. The idea is to not over-structure the diagram but let the brain structure it. As Sill says of creativity in general, “Creativity is found in the human ability to move beyond existing patterns to restructure the patterns themselves, and, as a result, to make a more sophisticated game” (1996, p. 296).

If our task is to restructure existing patterns then it may be invaluable to recognize the stability-enhancing patterns at the heart of each discipline, such as equilibrium between supply and demand in markets in economics, a supportive set of cultural attitudes toward social stratification in sociology, schemas that allow individuals to navigate daily life in psychology, rules of atomic attraction in physics or chemical reactions in chemistry. Such disciplinary systems may of course allow for some types of predictable but manageable change. Interdisciplinary linkages may be part of a wider systemic stability (as when cultural attitudes accept a certain degree of economic inequality) but are often the sources of change as when household technology and new service sector occupations encouraged changes in attitudes toward gender. The implication here is that these stability-enhancing disciplinary patterns should be an important component of our understanding of disciplinary perspective, and interdisciplinary researchers should appreciate that interdisciplinary understandings will often disrupt discipline-level conceptions of stability (see Szostak, 2017).

## Teamwork

Since we have identified the act of inspiration above with subconscious activity—and will see below the importance of relaxation and time in generating creative ideas—we may wonder whether truly creative ideas will emerge during team meetings. The literature on teams is divided, with some in the field lauding “brainstorming” and others expressing skepticism. It may be best to understand brainstorming not as “inspiration” but as “illumination”: It juxtaposes diverse ideas in a way that the subconscious minds of group members can then process. How



often do we leave a meeting and later on think “Oh, I wish I had said that?”. It is important, then, that team research allow lots of time for individual reflection. Such a strategy has the further advantage that teams do not overly narrow the connections that a team member might make by routinizing and criticizing (Paulus & Korde, 2013).

The literature on teams recognizes the value of bringing different types of people together. It is not good enough to simply ensure that one has the necessary range of disciplinary experts. It is useful, for example, to have a mix of optimists and pessimists. Analysis of the brain suggests that there are important cognitive differences across people (though we can change our cognitive types by exercising different parts of our brain): Some are particularly good at synthesis and imagination; some have strengths in analysis; some have leadership or organizational skills; some are good at connecting people and appreciating feelings. All of these can play a useful role at different stages in the creative process. It would be a mistake to only gather imaginative types. It is often thought, for example, that Enrico Fermi was far more important to the Manhattan Project (which created the atomic bomb) than General Lesley Groves who was its commander. But without the organization of knowledge and experimental data across several fields, Fermi would not have been able to create.

Students and researchers can usefully reflect on what type of thinker they are. They can then perhaps exercise different parts of their brain in order to develop other cognitive capabilities (see below). Or they can have an idea what types of people they should seek to collaborate with. We can, when teaching the IRP, use class discussions to (among other things) celebrate the advantages of bringing different types of thinking to bear on a particular question.

## **Skills and Attitudes**

We have focused so far on how individuals or groups can assemble the ideas that will be drawn upon in the creative act. But the literatures on creativity, design, and the IRP also talk about important skills and attitudes. All, notably, appreciate that creative skills and attitudes can be taught. The first thing to stress both here and in any course on the IRP, then, is that we have to move past the naïve idea of the occasional creative genius in order to appreciate that we all have creative potential.

Sternberg (2006) talks about three broad types of creative skill: The synthetic skills to draw new connections, the analytical skills to separate good from bad ideas, and the persuasive skills to overcome the resistance to novelty. The first set of skills can be developed through the sort of practices urged above; the other two will be addressed below. One of Sternberg’s observations deserves special attention: Students with creative skills do better in educational environments in which creativity is valued, but perform worse when memorization and rote learning is stressed. If we want to encourage creativity in our students, we need to reflect this in our pedagogy and grading rubrics.

Interdisciplinary scholars can celebrate the fact that “perspective taking,” an oft-noted interdisciplinary skill, is widely recognized as an important creative skill. Nor is this skill important just in human science. Spooner, (2004) speaks of a chemist imagining himself as a molecule. Einstein said that he had developed his theories of relativity by placing himself inside mass and energy; he imagined viewing clocks from a set of trains traveling at different speeds. There are numerous examples of this sort of perspective taking in the history of science.

Sternberg (2006) notes that people must decide that they want to exercise creative skills. It is often easier in life to go along with the crowd than to innovate. It is invaluable then to discuss with our students what sort of thinkers they aspire to be. If they want to take risks and be tolerant of ambiguity they need to practice such attitudes. Self-confidence is of critical importance here (Weisberg, 1993). Only as students learn that they have creative skills are they likely to embrace creative attitudes. Children are inherently creative but schooling tends to crush the creativity out of us all; we need to re-inspire our natural creativity.

Importantly, attitudes need to be internalized. The intermediate step(s) in the creative process occur largely subconsciously. While our subconscious is best suited to drawing novel connections, it is also guided by our emotions (Sill, 1996). If a person is not really committed to being creative their subconscious will not generate creative ideas. The person may not be consciously aware that they are avoiding creativity. They may be afraid of failure or afraid of ridicule. Note in this respect that both Isaac Newton and Charles Darwin withheld their theories for decades due to (in these cases conscious) fear of ridicule. An academic may subconsciously decide that they are content with a series of uncontroversial contributions, rather than risk a controversial insight. This outcome is particularly likely if they are not emotionally connected to the problem at hand. It is then important that the person comes either to care deeply about certain problems or comes to value novelty for its own sake. Intrinsic motivation is likely far more important for creative processes than extrinsic motivation (Sternberg, 2006).

The risk of ridicule is something that advocates of the IRP should confront directly. The simple fact is that disciplines discipline: Novel ideas are not always given a fair hearing precisely because they threaten existing belief sets and practices. There is, to be sure, a growing body of academics that self-identify as interdisciplinary in orientation. Yet interdisciplinary researchers can be confident that integrative insights will meet some resistance. It is best to confront this possibility consciously rather than allow one’s subconscious to decide whether the risk is worthwhile. Our efforts at the institutional level to instantiate quality interdisciplinarity within the academy can alleviate but not eliminate the emotional barriers to interdisciplinarity. This chapter has hopefully alleviated one concern: That a formal research process can impede creativity.

One way to conquer one’s fears is to confront them. It may be useful to purposely generate crazy ideas just to show that the world does not end when you do so. The worst that can happen is often far less than what we have feared. Bouncing crazy ideas off someone we trust may encourage us to develop more.

It should also be stressed that ignorance itself is stressful. As psychologists know, we all develop schemas that guide us through our daily lives and give us some sense of control. The creative insight is only possible if we have first recognized a problem that we care about (see above) and for which we lack an attractive solution. The creative insight will generate a greater feeling of relief than the discomfort associated with the previous tension. But if we do not consciously address that discomfort we may again subconsciously avoid it. Self-confidence again comes into play: We are more likely to appreciate our ignorance if we are confident that we can overcome this. Self-confidence comes into play also in later stages: We need to appreciate the weaknesses in our insights, and we need to be able to recognize when certain avenues of inquiry result in failure, for failure is an almost inevitable part of any creative process.

We all know as scholars that being published a few times (or teaching a few courses) helps us have confidence as we embrace a new topic. So we can think of ways to give students confidence through little exercises that allow them to achieve little bits of creativity, or by challenging them to use creative techniques in their private lives.

## **The Creative Act Itself**

We noted at the outset that creative acts tend to occur when we are not consciously thinking about the problem. Creative individuals thus have to divert themselves. Both meditation and exercise can induce the alpha waves that Hermann (1992) associates with creative acts. Purposely slowing one's breath may also help. Several recent studies suggest that mindfulness meditation enhances creativity (e.g., Colzato, Ozturk & Hommel, 2012). Hobbies that take your mind off work can be useful. Calming music is often suggested.

We are very conscious of our senses of sight and hearing. Our senses of touch, smell, and taste operate much more subconsciously: We often have trouble describing what we perceive through these senses. Activating these other senses may thus deactivate conscious processes. It could be that the subconscious draws connections across senses. Aromas are recommended in particular as a means to encourage creativity.

Creative writing courses often urge a process in which one just writes, trying to let the subconscious mind speak directly through one's fingers. The trick is to try not to consciously guide the writing. Writers may then find that they had ideas of which they were unaware. And writers may generate different ideas on different occasions, which can then be combined into a particularly compelling text. The same approach is not as commonly recommended for non-fiction writing. But if we accept that there are commonalities across all types of creativity, then it may prove useful there as well. We perhaps all know colleagues who are such perfectionists that they have trouble committing themselves to any text at all: The idea of writing provisional texts that are intended to be creative may be particularly important for them.

These various strategies may strike many interdisciplinary researchers as bizarre. They are quite distinct from such practices as close reading, critical thinking, and careful analysis. But if researchers will truly appreciate that the IRP is a creative process, then they need to follow strategies that get their entire brain working on their problem.

Nor should we just pursue these strategies when we arrive at step 8 in the IRP. Research shows that we can increase the number and length of the dendrites—which transmit electrical signals—in parts of our brain by exercising that part of our brain; while stress decreases dendrites (Fuchs & Flügge, 2014). If we wish to be occasionally creative, we should regularly pursue practices that encourage creative brain processes.

The time element deserves special attention. Interdisciplinary research takes time (especially as we iterate between conscious and subconscious processes). Carving out time to allow the subconscious to dominate is no easy task, especially when we face tight deadlines. Nor can we hope that it will do so when we are too tired to read or write: Though we sometimes get ideas while half-asleep the subconscious mind also works best when we have energy. We should also be aware of the opposing danger: that we are too relaxed in our overall approach to research and do not do all of the preparatory analysis to set the stage for inspiration. Either way, failure to organize our time may be a subconscious plot to avoid failure. Procrastination is common among creative types; the successfully creative develop strategies to overcome it.

There is a further temptation: Humans may keep busy simply to avoid the existential angst that can be associated with having time on our hands and thus the ability to reflect on what is missing in life. Creativity demands a willingness to spend time alone with ourselves.

## More Comprehensive Understanding

The post-inspiration steps in the IRP diverge a bit more than earlier steps from those recognized in the creative design literature. The literature on creativity tends to stress two stages: A critical evaluation process, in which the ideas thrown up by the subconscious are carefully evaluated and clarified, and a communication/selling stage in which others are convinced of the value of the creative ideas that we do develop. We will address communication/selling below. The “critical evaluation” stage is represented in the IRP by disparate steps such as constructing a more comprehensive understanding, reflecting, and testing.

The IRP could make more explicit the fact that our subconscious may present us with numerous ideas. Linkner (2011) stresses that inspiration often comes in little sparks rather than one big eureka; we need to nurture the sparks. Many of these ideas will not be useful. But one or a few may prove very useful. We thus need to envision a conscious process of careful selection of our better ideas, and then careful development of these. We must take care that we do not too quickly jettison

ideas at the first recognition of problems with these. The most creative ideas rarely burst from our subconscious ready to be applied in the world. As Klein notes in this volume (Chap. 4), we need a research heuristic that blends divergent thinking—which recognizes many possible solutions—and convergent thinking which identifies linkages.

We mentioned above how Newton and Darwin held back their ideas for years. They both knew that they could not “prove” their theories. Indeed, biologists still struggle to understand how certain complex organs emerged through natural selection, and physicists have come to appreciate that Newtonian mechanics is a special case of more general theories of mass and energy. We need, like Newton and Darwin, to evaluate whether our novel ideas have more strengths than weaknesses. And this will require the exercise of judgment. But if we demand perfection we will never create anything.

One of the critical revision tasks stressed in the design literature is identifying potential side-effects. These may be identified when testing an idea in the real world, and paying close attention to outcomes. As noted above with respect to the side-effects of previous designs, we can see these side-effects as invitations to modify ideas rather than jettison them (Darbellay et al., 2014). Modification may require further acts of creativity.

## Communication

The literature on creative design places great emphasis on this step. A creative idea is only useful if it is actually applied, and this means that others have to be convinced that it is a good idea. Sternberg (2006) thus associates creativity more with successfully arguing for novel ideas than with developing these. He notes that in both art and science there have been countless examples of work that is celebrated today but was rejected at first. But the creators persevered and only over time convinced others of the value of their creative insights.

Scholars should appreciate that persuading others is just as important as having good ideas in the first place. But there is a bias within scholarship to imagine that good ideas make it in the world on their own merits. Yet even Newton’s theory of gravitation—which could amazingly explain simultaneously how the planets move and why humans do not fly off the earth—needed to be carefully explained to others. As noted above no scientific discovery is perfect, and thus persuasion is an essential component of scientific creativity. This challenge, at least at the present time, is especially great for interdisciplinary insights which must overcome disciplinary resistance.

If the first lesson is that we should pay more heed to persuasion in the IRP, the second is that this is also a creative act. Again we must battle against the naïve presumption that logical argument and detailed evidence will inevitably win the day. Since no argument or evidence is perfect, rhetorical strategies become of crucial importance. Analogies, arguments from examples, appeals to emotion or authority,

and carefully crafted prose are among the rhetorical strategies that may mean the difference between an idea being accepted or rejected. Since these are creative acts, we thus have to bring the subconscious back in at this final step in the IRP.

And then emotions matter again. Many scholars are much more comfortable with the development part of academia than with the persuasion part. Such scholars may hold most tightly to the belief that ideas win on their own merits—it would be a wonderful world if this were true. They may tell themselves that it was fate, or just those nasty disciplines, that did not give their ideas their due. The lesson here is that persuasion is not an optional part of the creative process. Sternberg (2006) notes that creative people often thrive on constructive conflict. While thriving may not be essential, the creative academic needs to not avoid or downplay the importance of persuasion—or allow their subconscious to do so. If they do then academic discourse will be dominated by those who are better at persuasion than at developing good ideas in the first place.

Researchers may hope that their ideas will be greeted with immediate applause. But the fact is that the most creative ideas are often greeted with skepticism. Scholars can take guidance from those many insights that were viewed skeptically at first but came to be judged transformative over time. Moreover, one never has a better opportunity to persuade than when one's ideas are critiqued, for then one faces the simpler task of pointing out weaknesses in counter-arguments. More prosaically, while it may be harder to get creative ideas published, these have a much greater chance of one day being widely cited. Conscious appreciation of these facts of life may help subdue subconscious fears of scholarly objection to creative ideas.

## Evaluation

How should editors or referees judge the creativity of a piece of research? They can look at the outcome and evaluate its novelty and usefulness. The last part will be especially tricky, for the utility of truly novel ideas is often not immediately obvious. They can also look at the process to see whether creativity-enhancing strategies were pursued. In judging student work this should perhaps introduce an element of fairness into the evaluation for creativity is a risky project and sometimes one does all the right things and does not have a creative breakthrough. Note also that a research paper that is not itself terribly creative may spark creativity in others—perhaps because the first paper missed one key element that another can add.

## Institutions

We have mentioned the institutional environment above more than once. Hemlin, Olsson, and Denti (2013) summarize the empirical research on creativity, noting that this has identified valuable individual and team characteristics but also

supportive institutional elements: A supportive environment, including encouragement for innovation, sufficient resources, access to expertise and information, autonomy, and an empowering leadership style. Our universities, granting agencies, and journals can encourage creativity by being more supportive of it: Universities and granting agencies can appreciate that creativity is risky and time-consuming; journals can see value in controversial ideas. Perhaps most importantly, journals could recognize that no argument is perfect, and that pretending otherwise encourages a scholarly focus on minutiae.

We noted above that it would be feasible to change the way we organize information in a way that would facilitate interdisciplinarity and creativity. We can note here that these changes would make it easier to find insights that received little attention when first published. Such an institutional change might thus tip the balance away from ideas that are sold well toward ideas that are useful. All of these institutional enhancements could encourage researchers to employ the various creativity-enhancing strategies outlined above.

## Conclusion

The IRP is a creative design process: It follows a similar set of steps and can/should employ many of the same strategies. Various strategies can be pursued in the early steps of the process which increase the likelihood and degree of creativity—but these strategies are inherently risky and time-consuming. Just as it is useful for creative design students to be acquainted with the creative design process, the IRP can encourage rather than detract from scholarly creativity. But this will be the case only if researchers are acquainted with the many trade-offs along the way. The creative act itself can be encouraged by a range of practices quite distinct from those pursued in earlier steps. We then need to carefully evaluate the necessarily imperfect ideas that our subconscious generates. Perhaps most importantly of all, we then need to engage in the essentially creative act of persuasion. This paper has urged a variety of creative strategies that are entirely compatible with the IRP: Collectively these show that the IRP can and should encourage creativity.

**Acknowledgements** I thank Michelle Phillips Buchberger, Julie Thompson Klein, Bill Newell, Allen Repko, and James Welch IV for very helpful advice.

## References

- Association for Interdisciplinary Studies (AIS). (2013). *About interdisciplinarity*. Available at: <http://www.oakland.edu/ais>.
- Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C., & Schramm, E. (2012). *Methods for transdisciplinary research: A primer for practice*. Frankfurt/New York: Campus.
- Buzan, T. (2010). *The mindmap book*. London: BBC Books.

- Colzato, L. S., Ozturk, A., & Hommel, B. (2012). Meditate to create: The impact of focused-attention and open-monitoring training on convergent and divergent thinking. *Frontiers in Psychology*, 3, 116.
- Darbellay, F., Moody, Z., Sedooka, A., & Steffen, G. (2014). Interdisciplinary research boosted by serendipity. *Creativity Research Journal*, 26(1), 1–10.
- Dunbar, K. (1999). Science. In M. A. Runco & S. R. Prentky (Eds.), *Encyclopedia of creativity* (Vol. 2, pp. 525–531). San Diego: Academic Press.
- Doppelt, Y. (2009). Assessing creative thinking in design-based learning. *International Journal of Technology and Design Education*, 19(1), 55–65.
- Fuchs, E., & Flügge, G. (2014). Adult neuroplasticity: More than 40 years of research. *Neural Plasticity*, 5, 1–10.
- Hemlin, S., Olsson, L., & Denti, I. (2013). Creativity in R & D. In K. Thomas & J. Chan (Eds.), *Handbook of research on creativity* (pp. 508–521). Cheltenham: Elgar.
- Herrmann, N. (1992). *Brain dominance and creativity*. Paris: Retz.
- Klein, J. T. (1990). *Interdisciplinarity: History, theory and practice*. Detroit: The Wayne State University Press.
- Linkner, J. (2011). *Disciplined dreaming: A proven system to drive breakthrough creativity*. San Francisco: Wiley.
- McGuinness, M. (2011). *20 creative blocks and how to break through them* [Ebook]. Wishful Thinking.
- Mumford, M. D., Giorgini, V., Gibson, C., & Mecca, J. (2013). Creative thinking: Processes, strategies and knowledge. In K. Thomas & J. Chan (Eds.), *Handbook of research on creativity* (pp. 249–264). Cheltenham: Elgar.
- Pasteur, L. (1854/1937). *Oeuvres complètes réunies par M. Pasteur Vallery-Radot, Mélanges scientifiques et littéraires* (Tome 7). Paris: Masson et Cie Editeurs.
- Paulus, P. B., & Korde, R. (2013). How to get the most creativity and innovation out of groups and teams. In K. Thomas & J. Chan (Eds.), *Handbook of research on creativity* (pp. 493–507). Cheltenham: Elgar.
- Repko, A., & Szostak, R. (2016). *Interdisciplinary research: Process and theory* (3rd ed.). Thousand Oaks: Sage.
- Sill, D. J. (1996). Integrative thinking, synthesis, and creativity in interdisciplinary studies. *Journal of General Education*, 45(2), 129–151.
- Simonton, D. K. (2013). What is a creative idea? Little-c versus Big-C creativity. In K. Thomas & J. Chan (Eds.), *Handbook of research on creativity* (pp. 69–83). Cheltenham: Elgar.
- Spooner, M. (2004). Generating integration and complex understanding: Exploring the use of creative thinking tools within interdisciplinary studies. *Issues in Integrative Studies*, 22, 85–111.
- Sternberg, R. J. (2006). The nature of creativity. *Creativity Research Journal*, 18(1), 87–98.
- Szostak, R., Gnoli, C., & López-Huertas, M. (2016). *Interdisciplinary knowledge organization*. Berlin: Springer.
- Szostak, R. (2017). Stability, instability, and interdisciplinarity. *Issues in Interdisciplinary Studies*, 35, 65–87.
- Taura, T., & Nagai, Y. (2010). Discussion on direction of design creativity research (Part 1)—New definition of design and creativity: Beyond the problem-solving paradigm. In T. Taura & Y. Nagai (Eds.), *design creativity* (pp. 3–8). Berlin: Springer.
- Weisberg, R. (1993). *Creativity: Beyond the myth of genius*. New York: W.H. Freeman.
- Welch, J. (2007). The role of intuition in interdisciplinary insight. *Issues in Integrative Studies*, 25, 131–155.
- Wong, Y., & Siu, K. (2012). A model of creative design process for fostering creativity of students in design education. *International Journal of Technology and Design Education*, 22(4), 437–450.



## Author Biography

**Rick Szostak** Ph.D., is professor of economics at the University of Alberta, where he has taught for thirty one years. He is the author of a dozen books and 50 articles, all of an interdisciplinary nature. Several of his publications address how to do interdisciplinary research, teach interdisciplinary courses, administer interdisciplinary programs, or organize information in order to facilitate interdisciplinarity. As an associate dean, he created the Office of Interdisciplinary Studies at the UofA, the Science, Technology and Society (STS) program, an individualized major, and two courses about interdisciplinarity (which he has taught several times). He has twice served as co-editor of the interdisciplinary journal *Issues in Integrative Studies*. He was president of the Association for Interdisciplinary Studies (AIS), 2011–2014.

Creativity, Design Thinking and Interdisciplinarity

Darbellay, F.; Moody, Z.; Lubart, T. (Eds.)

2017, XXII, 201 p. 23 illus., Hardcover

ISBN: 978-981-10-7523-0