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Cognition, creativity, and entrepreneurship

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Abstract

Cognitive approaches to creativity are discussed as they relate to an important task of entrepreneurs: generating novel and useful ideas for business ventures. Attention is given to the paradoxical role of knowledge, which can either enhance of inhibit creativity, as well as to the properties of knowledge and a selected set of processes that influence the originality of newly generated ideas. Experimental findings are discussed along with suggestions about how those findings might be translated to practical applications.

Keywords: Cognition; Creativity; Entrepreneurship

1. Executive summary

Entrepreneurs face many significant challenges, not the least of which is generating or recognizing ideas that have the potential to be developed into appealing goods or services. Successful ideas are often a balance between novelty and familiarity: new and different enough to capture consumers' attention, but familiar enough to not be misunderstood or rejected out of hand as too radically different. Because the creative cognition approach provides a theoretical framework for understanding the thought processes involved, it has the potential to serve as guide to more effective idea development.

The creative cognition approach views creative ideas as being the natural result of applying basic mental operations to existing knowledge structures. The originality of a given idea, that is, the balance between its novelty and familiarity, will be determined by

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the processes employed and the way in which existing knowledge is accessed. Processes examined in this paper include conceptual combination, analogy, and initial problem formulation.

Work on conceptual combination reveals that when two previously separate concepts or images are merged into a single new unit, novel properties can emerge that were not obviously present in either of the separate components, and that the effect is particularly strong for dissimilar or divergent concepts. Such novelty can be exploited to develop new product ideas or market niches.

Analogy, or the mapping of knowledge from a familiar domain to a less familiar one, is central to creative developments in science, art, music, and literature and may also have applicability to entrepreneurship, as when a new successful venture is based on the principles that operate in other current successful ventures. Analogies can also vary in terms of their conceptual distance (e.g., an atom is similar to a solar system versus a washing machine is similar to a dishwasher) and main purpose (generating an idea versus explaining an idea to someone else), and understanding these distinctions can help with the multiple tasks of entrepreneurship.

Problem formulation influences the approaches people adopt to solving problems and thereby has a lot to do with their ultimate success in solving the problems. Problems can be defined very concretely or very abstractly (e.g., develop a new disc brake system versus develop a new device for transforming the kinetic energy of a moving vehicle), with the former leading to less novelty but more familiarity. Knowing whether one's goal is more or less novelty can help to determine the most productive approach.

The work presented in this paper is largely empirical research on fundamental processes, but suggestions are made along the way about how to translate that work into entrepreneurial applications. In contrast to many contemporary approaches to creativity, the advice here is not to throw out everything you already know and start over. Instead, it is to exploit everything you know by the judicious application of basic mental operations.

2. The entrepreneurial challenge

Novel and useful ideas are the lifeblood of entrepreneurship. To be successful, entrepreneurs must generate valuable ideas for new goods or services that will appeal to some identifiable market, and having identified those potential opportunities, they must figure out how to bring the project to fruition. Depending on the need for capital to develop the new venture, entrepreneurs may even need to craft ideas for how to convince others of the value of the project. Because novelty and usefulness are the hallmarks of creative ideas, it is not surprising that the possible connections between creativity and entrepreneurship have been of interest for some time (e.g., Gilad, 1984; Whiting, 1988).

The present article examines the nature and origins of novel ideas with a particular focus on how existing knowledge shapes those ideas and on the cognitive processes by which people access and manipulate their knowledge. Although theoretical concerns are primary, practical suggestions for improving creative functioning are also discussed.

3. A creative paradox and a cognitive perspective

An examination of human endeavors yields an interesting paradox. Throughout history, coexisting with a cornucopia of creative accomplishments in art, music, science and technology, we also find stunning examples of needlessly constrained thinking. Considering creativity first, in addition to historically noted undertakings that have radically altered the way we live, new discoveries and advances are being made on a daily basis in a variety of fields, and as readers of this journal will no doubt be aware, new products and services are constantly being brought to the market by creative entrepreneurs. Clearly, humans have the capacity to move beyond what currently exists to generate and implement new ideas.

It is also clear, however, that people's attempts at creativity often reveal unnecessarily limited thinking. To give just one example, Barker (1993) has claimed that Sony nearly missed a golden opportunity when they temporarily abandoned work on developing music CDs in the mid-1970s because they judged that putting 18 hours of music on a single CD would not be commercially viable. Why 18 hours? According to Barker's account, it was because they used the size and shape of LP record albums (12 in. diameter circles) as their starting point, and a CD of that size would presumably hold a huge amount of music. The designers ultimately overcame the constraint, but initially their knowledge about LPs limited their thinking. Barker and others (e.g., Ward et al., 1995) have provided many additional anecdotes regarding constrained thinking, and there is an inestimable number of creative failures that are lost to history and remain undocumented simply because they led nowhere. Thus, along with our enormous capacity to create, humans appear to have an equally impressive capacity to become stuck in the past.

How are we to resolve this paradox of creativity alongside constraint? How can people who have the capacity to be so innovative also be so unoriginal? From the perspective of cognitive psychology, these seemingly contradictory tendencies can be seen as alternative manifestations of the more general propensity of people to store information about their experiences in organized knowledge structures and then access that knowledge for use in subsequent tasks. Sometimes knowledge provides a bridge to the next new development and sometimes it becomes a fence that blocks our path. By examining cognitive processes and structures, it is hoped that individuals and groups can better understand how to access and use existing knowledge in more creative ways—to build more bridges and fewer fences. What are the aspects of cognitive structures that constrain or direct the shape of newly formed ideas? What are the best ways of accessing, manipulating, and transforming knowledge to produce novel and useful entities?

In a more general sense, models that are primarily cognitive in nature view creative products as resulting from the application of mental operations to stored information. For example, Runco and Chand (1994, 1995) have described a model that includes processes of problem finding, ideation, and evaluation that interact with one another and with knowledge and motivation to determine creative outcomes. An alternative, though not incompatible framework, is the Geneplore model (Finke et al., 1992; Ward et al., 1999b), which characterizes creative endeavors as an interplay between generative processes that produce candidate ideas possessing varying degrees of creative potential, and exploratory processes

that extend or modify those initially generated ideas judged to be most promising. A crucial strength of these and other cognitive models is that the broad groupings of processes they highlight (e.g., ideation, generation) are really just umbrella terms for more specific processes that have received considerable investigation by cognitive psychologists. It is only by examining the details of those specific processes and how they operate on particular aspects of knowledge that a clear understanding of the emergence of creative ideas will be obtained.

4. Conceptual combination, other transformational processes and the origins of novel ideas

So what specific processes might a would-be entrepreneur use to come up with a new idea for a product or service? To gain a perspective on this question, consider the following obstacle to novelty: the truism that one cannot produce something from nothing—ex nihilo nihil fit—applies to ideas as well as to tangible things. Creative ideas do not appear, ex nihilo, full-blown in the minds of their originators, but rather must be crafted from the person's existing knowledge. But if new ideas are rooted in old ones, how does novelty emerge? How does the innovator move beyond the constraints imposed by that old knowledge to differentiate the new from the old, that is, to develop something original?

4.1. Conceptual combination

A variety of processes exist by which people can modify, extend, or otherwise transform their stored knowledge, but one of particular interest is conceptual combination, a process whereby previously separate ideas, concepts, or other forms are mentally merged. Conceptual combination bears a special relationship to creativity, having been mentioned frequently in historical accounts of creative accomplishments (e.g., Rothenberg, 1979; Thagard, 1984; Ward, 2001; Ward et al., 1995). Rothenberg (1979), in particular, has argued that simultaneously entertaining or integrating two opposing ideas, a process termed Janusian thinking, underlies creative acts as diverse as the paintings of da Vinci, the symphonies of Mozart, and the scientific reasoning of Einstein. In addition, combining concepts is a crucial component in several process models of creative functioning (e.g., Davidson, 1995; Mumford et al., 1991; Sternberg, 1988), and because the capacity to interpret and produce combinations is a fundamental one that underlies our use of language, it has been the focus of intense scrutiny by cognitive psychologists (e.g., Costello and Keane, 2000; Gagne, 2000; Hampton, 1987, 1997; Murphy, 1988; Wisniewski, 1997a,b). Conceptual combination also appears to be directly relevant to the needs of entrepreneurs in search of new ideas to pursue.

Combining concepts may be an attribute of the eminently creative, but it is also a basic capacity available to all of us, and thus is a procedure that may be harnessed to enhance everyday creativity. For example, even a brief consideration of new word combinations that have entered our collective lexicon recently (e.g., web hosting, mouse pad, sport drink, personal trainer, and yes, the infamous "hanging chad" from the contested 2000 presidential election) confirms that people are quite capable of creating and interpreting novel pairings. More importantly, it

highlights that the creative potential of conceptual combination resides, at least in part, in the fact that combinations are not mere summations of the concepts being merged. Hanging chad, for instance, carried with it the notion of ambiguity with respect to a voter's intent, a property not generally thought of as being true of either hanging things or chad considered separately.

Properties that are apparent in people's interpretations of a combination but not in their representation of either of its components, are referred to as *emergent features*. Although emergent features from simple word pairings are not as dramatically impressive as the kinds of real-world creative advances described by Rothenberg (1979), they are nevertheless novel, and they reveal that even the simplest merging of two previously separate concepts can lead to ideas that are substantially different from either of those separate concepts.

Carefully controlled laboratory research also confirms that this most basic form of conceptual combination can be the source of novel ideas, and it supports Rothenberg's (1979) contention that combining concepts with opposing meanings is particularly evocative. For example, Estes and Ward (2002) had a sample of college students interpret various types of adjective-noun combinations. Of most interest, when the adjectives and nouns were opposing in meaning (e.g., healthy illness) the participants' interpretations contained more emergent properties than when the terms represented more typical pairings (e.g., harmful illness). A healthy illness, for example, might be one that temporarily incapacitates its victim, thereby preventing the person from engaging in some activity that could have resulted in more harm (e.g., taking a fateful trip). A harmful illness, by contrast, is just one that causes some harm to the body—not a particularly novel construct.

Other laboratory studies also provide evidence that discrepancy or dissimilarity of components can yield novelty. Kunda et al. (1990), for example, asked people to describe members of a somewhat surprising combination of social categories (e.g., Harvard-educated carpenters) and found that people included properties (e.g., nonmaterialistic) that were not part of their descriptions of either social category considered separately (e.g., Harvard-educated people or carpenters). Likewise, Wilkenfeld and Ward (2001) had people interpret novel noun–noun combinations and found that dissimilar combinations (e.g., motorcycle carpet) led to more emergent properties than did similar combinations (e.g., sled ski). Evidently, when people attempt to make sense of novel combinations and, in particular, when they reason out how two discrepant concepts can fit together, the process can yield emergent properties that do not come to mind in considering either concept in isolation. Something new emerges from the mix.

From a practical standpoint, the laboratory findings suggest that novel ideas for useful products or marketing appeals might be generated by mentally combining opposing concepts (e.g., Ward et al., 1995). Consider, for example, the appeal to the "affordable luxury" of the Nissan Altima. The concepts of affordability and luxury would ordinarily be thought of as being in opposition to one another, with many affordable but basic vehicles as well as many luxurious but expensive ones. Thinking about the combination of affordability and luxury opens a new set of possibilities in the space of vehicles. As another oppositional example, "nonalcoholic beer" might be expected to appeal to health conscious or socially responsible individuals. More generally, then, thinking about opposing wants of consumers (e.g., excitement and tranquility, solitude and companionship, and comfort and ruggedness) may help to identify gaps in a product space and suggest a particular target audience or marketing

appeal. What about a travel agency that offered "rugged comfort" tour packages? Would they appeal to those who fancy themselves as explorers, but who also like the comforts of home?[1]

One reason conceptual combination might be especially useful in entrepreneurial creativity is that combinations often represent specializations of their base concepts or head nouns, even when no opposition in meaning is present (e.g., Murphy, 1988). To use a noncreative example, a pocket watch is a special type of watch with features that differentiate it from other types of watches. Consequently, a whole series of minor variations on a product can result from combining new modifying concepts with the same head noun concept. The idea of concept specialization is clearly not lost on athletic shoe manufactures who, at a minimum, have produced the specialized combinations of running shoes, walking shoes, basketball shoes, court shoes, and cross training shoes. Similarly, we now have electric scooters and in-line skates, and it would be no surprise to shortly see electric in-line skates.

It is also important to note that novel outcomes can result from a variety of procedures for merging concepts. People need not be limited to combining pairs of words or interpreting their meanings to produce new ideas. For example, Mobley et al. (1992) gave participants a set of problems in which they had to combine four exemplars of each of three categories to generate a new category that would account for or explain the presence of all of the exemplars in that new category. They were to label, define, and list new exemplars of the combined category. In some problems, the three starting categories were closely related and in others they were not. Importantly, the novel categories the participants generated for the latter types of problems were rated as more original than those they generated for the former types. Apparently then, as with the results of studies already described, the need to integrate more discrepant pieces of information provided a boost to originality.

The work of Mumford et al. (1997) is also important in that it reveals that the outcome of conceptual combination depends on what people are instructed to consider. Considering shared attributes across the exemplars appears to be more effective for closely related concepts, whereas considering more metaphoric kinds of interpretations is effective with discrepant ones (Mumford et al., 1997). This makes sense because related concepts share many attributes, whereas discrepant ones do not and integrating them may require people to go beyond ordinary meanings toward more metaphoric ones.

Research also shows that a combination does not have to involve verbal units at all to be a stimulus for creativity. Merging visually presented abstract forms, for example, can also lead to emergent new ideas. Rothenberg and Sobel (1980) showed that participants who viewed two images superimposed on one another created metaphors that were rated as more creative than those produced by participants who saw the same images next to one another. Finke (1990) also showed that people who mentally combined randomly selected visual forms were able to develop ideas for inventions and discoveries for a variety of domains

[1] Readers interested in getting a sense of the creative potential in some unrelated combinations may wish to play around with the web application I have developed at http://creativityforyou.com/combomaker.html.

under a wide range of procedures. Although superimposed or merged images do not always lead to more creative outcomes (e.g., Sobel and Rothenberg, 1980), the results are suggestive that combined images can, at least under some circumstances, be a stimulus to originality.

More broadly, combinations need not be limited to simple concepts, but might extend for example, to musical styles (e.g., Gregorian reggae), artistic styles (e.g., Baroque cubism), and perhaps more practically, to diverse consumer needs. Oddly enough, when considering the latter, combinations can push ideas in the opposite direction from specialization as when one considers how multiple needs can be satisfied by a single product. For example, people pursuing outdoor adventures might want to ward off bugs, protect their skin from the damaging rays of the sun, and moisturize their weather-dried skin. Although they might purchase three separate products to meet those separate needs, a single product that combined all of those functions might have tremendous appeal. Certainly, Avon is banking on just that possibility with their line of bug repelling, UV blocking moisturizing creams. Recent trends in digital products also seem to reflect an effort to combine as many functions as possible into a single device of the smallest possible proportions.

Interestingly, one does not need special training to interpret combinations in ways that generate ideas for new products. For example, I gave students in one of my courses the task of interpreting unusual combinations, one of which was "computer dog." They came up with a variety of interesting interpretations, but a particularly intriguing one was the idea that a computer dog was a peripheral device, similar to a mouse, for interacting with a computer. The device had a track ball and four buttons arranged in the shape of a dog's footprint, emergent properties that would not be considered as parts of ordinary dogs or computers.

It is important to note, however, that an idea for a new product is not the same as the finished product itself. As noted in the Geneplore model (Finke et al., 1992; Ward et al., 1999a,b), the ideas initially generated in response to a particular situation may not be creative products in themselves. Rather they represent candidate ideas or preinventive forms that may or may not lead to a creative product as they are explored, modified, transformed, extended, or even rejected on the basis of additional exploratory thought processes. Clearly for some combinations, much development is necessary to bring the idea to fruition, but combinations can at least provide a starting point.

Conceptual combination can serve many different creative purposes. Some combinations may simply represent convenient labels invented to communicate the meaning of new concepts as they are identified or become relevant in some way (e.g., soccer mom, religious right, and hanging chad). In these cases, the word pair is the result of a newly emergent idea rather than vice versa. An entrepreneur using this form of conceptual combination might expend effort to develop a catchy phrase that captures the essence of a new product or service. Sometimes, conceptual combinations represent a problem to be solved (e.g., computer virus, road rage, and digital divide) and when they do so, they can provoke efforts at problem solutions (e.g., virus protection software). Finally, as noted throughout this section, combinations can spark ideas for variations on existing products or new classes of products altogether.

4.2. Analogical reasoning and other processes

The intense focus on conceptual combination should not be taken as an indicator that it is the only source of novel ideas, but merely that it is a particularly generative process with historical ties to creativity about which much has been learned. Another process with a special link to creativity that has also undergone careful experimental examination is analogical reasoning or transfer, the application or projection of structured knowledge from a familiar domain to a novel or less familiar one (e.g., Gentner et al., 2001; Holyoak and Thagard, 1995).

Commonly cited examples of analogy in creative endeavors abound, such as Rutherford's use of a solar system as a model for how the hydrogen atom was structured and Robbins, Laurents, Bernstein, and Sondheim's adaptation of Shakespeare's *Romeo and Juliet* to the context of a 1950s New York City gang conflict in *West Side Story*. Meticulous case studies have also detailed the role of analogy in major creative accomplishments, such as Kepler's reasoning about planetary motion (Gentner et al., 1997), Edison's development of an electric light distribution system (Basalla, 1988; Friedel and Israel, 1986), and the Wright brother's efforts to craft a workable flying machine (Crouch, 1992). Not surprisingly, then, analogy has been a key ingredient in proposals for enhancing creativity (e.g., Gordon, 1961) and has been listed as a component process in cognitive process models of creativity (e.g., Finke et al., 1992).

The transformational power of analogies derives, at least in part, from the fact that good analogies connect the familiar and novel domains at very deep levels, not merely at the surface (e.g., Gentner, 1983, 1989; Gentner and Toupin, 1986). Consider the solar system/atom analogy. It means that, just as planets orbit around a more massive central body, the sun, electrons may orbit around a more massive central body, the nucleus. But the nucleus and electrons do not resemble the sun and planets in any superficial way. The nucleus of an atom does not appear yellow like the sun, nor does it have a high surface temperature. The electrons are not as big as planets. What matters is that there are corresponding objects that bear particular relations to one another. Likewise, New York City of the 1950s did not have to resemble Verona of centuries earlier, and Maria did not have to look or dress like Juliet. What mattered is that two young people were in love, but were also connected to larger groups that were in conflict with one another.

As with conceptual combination, there are various manifestations of analogy and multiple purposes to which analogies might be put. The most obvious purpose is applying the knowledge from one domain as a kind of model to help in understanding or developing ideas in another domain, but another purpose is to communicate a new idea to others in a concise, understandable way. Dunbar's (1997) on-line observations of the reasoning of intact molecular biology lab groups, for example, led him to conclude that analogies between distant domains (e.g., solar system/atom) are quite rare and that many creative advances are instead the result of analogies between close conceptual domains (e.g., between two different viruses). Dunbar went on to argue that distant analogies may be developed subsequent to a major discovery and serve as a means of communicating the new concept to others. So for example, Rutherford may not have gotten the idea for how an atom might be structured by

considering the structure of the solar system. Rather, he may have chosen that analogy as way of describing his idea, which had its origins in some other source. This focus on analogy as a means of communicating a new idea seems especially relevant to entrepreneurs, who must eventually be able to sell other people on their idea. The right analogy can be very persuasive, as for example when proponents of intervention in the Gulf War compared the situation to the early days of World War II, and warned about the dangers of appeasement.

Near analogies appear to have great potential as sources of ideas for new products. Consider, for example, the line of variations on the phenomenally popular game of *Monopoly*, such as the windy city variant, *Chicago in a Box*. The streets and landmarks are different, but the underlying structure of the game is the same. Similarly, other popular items, such as Trivial Pursuit and Magnetic Poetry (itself an interesting conceptual combination) have served as models in the development of variations for particular target audiences. A potentially productive strategy, then, is to use successful products as the source domain and project the important underlying relations among the elements of that product onto a new situation.

A host of other processes that have been investigated by cognitive psychologists also have the potential to serve creative purposes. These include the reorganization of existing category knowledge to form ad hoc or goal-derived categories to meet a particular need (e.g., Barsalou, 1983, 1991; Mumford et al., 1994), metaphoric interpretation, which can yield emergent properties (e.g., Tourangeau and Rips, 1991), reasoning from unexpected observations (Dunbar, 1997), and the constructive forgetting of interfering information during incubation (e.g., Smith, 1995). These and other processes described in more application-oriented sources (e.g., Perkins, 2000; Ward et al., 1995; Weber, 1992) may well be of use to entrepreneurs in generating and developing creative solutions.

5. Abstraction, problem formulation, and originality

There is, of course, more to being creative than combining concepts, using analogies, and applying other transformational processes. At least since the groundbreaking work of Csizkzentmihalyi and Getzels (1971) showing a link between the exploratory activities of artists and the quality of their subsequent creations, creativity researchers have been sensitive to the idea that the way people formulate problems or tasks is an important component of the creative process. In addition to the Runco and Chand (1994, 1995) model described earlier, several other creativity models include steps such as problem construction, problem definition, and problem discovery (e.g., Basadur, 1994, 1997; Mumford et al., 1991; Sternberg, 1988; Treffinger et al., 1994). Implicit or explicit in these models is the belief that the way in which people conceptualize a problem strongly influences their likelihood of achieving an original or creative solution.

By distinguishing between processes associated with initial problem formulation and subsequent procedures, such models draw attention to that fact that creativity may be more than just problem solving. Particularly in real world settings, in which people are confronted with ill-defined tasks, creative behavior requires several steps. Generally, innovators are not

simply handed clearly delineated problems, which they then begin to solve. Instead, doing something creative often requires people to construct, formulate, or otherwise define the problem or task to be accomplished, to retrieve from memory or seek out relevant information, and to generate and evaluate potential courses of action.

Mumford et al. (1994) provided experimental evidence that engaging in problem formulation increases the quality and originality of problem solutions. They had college students perform a creative generation task in which they were to develop a marketing survey and advertisements for a fictitious product. Students in a problem construction condition were instructed to (a) list important factors to consider, and (b) restate the problem prior to engaging in the task, whereas those in the no problem construction condition were not. Importantly, those in the former condition produced ideas that were higher in quality and originality than those in the latter condition. Mumford et al. suggested that problem construction activities allowed students to consider a range of options rather than jump at the first idea that came to mind.

Aside from the issue of engaging in some amount of problem construction is the question of the form that construction takes and how it either enhances or inhibits creativity. Although retrieval of existing knowledge is necessary for crafting successful innovations, the form in which that knowledge is accessed can vary. Those variations can serve as indicators of how people have formulated or defined their creative task, and they can have a major effect on the originality of resulting ideas. Consider again Barker's (1993) example of Sony's initial efforts to develop music CDs. Although members of the development team might have accessed all sorts of specific and abstract information about methods of storing musical information, by Barker's account, they seem to have retrieved and relied on a very specific entity as a model, namely, the LP record album. Put differently, they seem to have formulated their problem as one of developing a sort of "digital LP record album," and that formulation limited their thinking.

Another example of the same phenomenon is that railway passenger cars were initially patterned directly after stagecoaches, including external seating for the conductor, with dangerous and even deadly consequences for the conductors who fell from the vehicles (e.g., Ward, 1995). Passenger cars were important innovations contributing to the railroad's radical transformation of travel in America, but retaining certain properties from the previous stagecoach model resulted in initial designs that were nonoptimal for the new situation. Although the designers of early railroad passenger cars could have retrieved abstract information about transportation in general, they nevertheless relied heavily on a highly specific type of vehicle, the stagecoach, and modified it only slightly for the new situation. Put differently, they seem to have formulated or defined their problem as one of adapting stagecoaches for use on railroad tracks instead of, for example, devising a completely new type of vehicle that would have the properties needed to meet the new demands of rail transportation.

There is a multitude of pressures that operate on individuals who attempt to devise new real world products, and often there are compelling external constraints that can lead designers to adopt particular approaches to the task. However, there are also internal, cognitive constraints related to the structure of categorical knowledge and how it is typically

accessed that contribute to the tendency to base new ideas on specific instances of a given category. It is those more cognitive factors that are of most interest in the present analysis.

Much knowledge can be thought of as organized into taxonomic categories with a definite hierarchical structure. LP record albums, for example, can be thought of as instances of the more general category of records, which in turn are instances of music storage devices, which in turn are instances of storage devices, and so on. Perhaps more important than the existence of hierarchies is the fact that a particular level of specificity within a given hierarchy, termed the basic level, seems to dominate over others (e.g., Rosch et al., 1976). The basic level resides between the most specific and most general levels of a hierarchy and it is the level at which people most characteristically conceptualize a given object. To illustrate this point, when shown a picture of an orange tabby cat, most observers will call it a cat rather than an orange tabby, a tabby, a feline, a mammal, an animal, a living thing, or a tangible thing. Any of those more specific or more general characterizations would be accurate and could be accessed, but under most circumstances, they are not used as readily or as often as the basic level representation of "cat."

A wealth of research documents the dominance of the basic level in less creative forms of cognition, and there is reason to believe that it plays a powerful role in creative cognition as well. If people's most characteristic mode of representing information is at the basic level, then it stands to reason that that tendency would influence the way they mentally construct situations and the information they retrieve to deal with those situations. More formally, Ward (1994, 1995)and Ward et al. (2000) have proposed the path-of-least-resistance model, which states that when people approach the task of developing a new idea for a particular domain, they tend to retrieve fairly specific, basic level exemplars from that domain and select one or more of those retrieved instances as a starting point for their own creation. Having done so, they then project many of the stored properties of those retrieved instances onto the novel ideas they are developing. Consequently, the new creation can be expected to resemble the old exemplar closely. In other words, retrieving basic level exemplars and basing new entities on their properties can constrain the form of the new idea and reduce its apparent originality.

The results of laboratory studies provide direct evidence on this tendency to retrieve basic level category exemplars as starting points for developing creative products. For example, Ward (1994) had college students imagine and draw animals that might live on other planets, and found that the dominant approach to the task was to retrieve one or more specific instances of Earth animals (e.g., dogs and cats) and to use those as models for the imaginary extraterrestrial. Not too surprisingly, given such an approach, the imagined creatures bore a striking resemblance to Earth animals, including bilateral symmetry, legs, eyes located in heads at the tops of bodies, and so on, and this tendency has been found to remain even when people are instructed to develop creatures that are wildly different from Earth animals (Ward and Sifonis, 1997).

This tendency to base novel entities on specific, basic level exemplars has also been shown for the domains of fruit and tools (Ward et al., 2002). In addition, although investigators have not always assessed their participants' approaches to creative idea generation, the tendency of novel ideas to be structured in predictable ways by existing conceptual frameworks is a robust one that has also been observed in young children (Cacciari et al., 1997; Karmiloff-Smith,

1990), gifted adolescents (Ward et al., 1999a), science fiction authors (Ward, 1994), design engineers (Condoor et al., 1993), and other creative individuals (Ward, 1995; Ward et al., 1995). The phenomenon has also been shown to extend to a variety of conceptual domains, such as imaginary coins (Rubin and Kontis, 1983), faces (Bredart et al., 1998), and restaurants (Sifonis, 1995). Thus, it is reasonable to assume that the tendency to retrieve and rely upon basic level domain instances is a general one underlying this broad range of structured imagination phenomena (Ward, 1994, 1995).

More important than the overall findings of these creative generation studies, however, is the fact that the originality of people's creations was related to their approach to the task. Specifically, individuals who reported retrieving and using specific examples of Earth animals generated imaginary extraterrestrials that were rated as significantly less original than those of individuals who did not use specific examples of Earth animals (Ward, 1994). Although the strategies of the latter individuals were varied, they tended to take the form of considering more abstract information, such as the properties a creature might need to survive on a planet that had certain characteristics. Similarly, in a study that asked participants to imagine and depict imaginary fruit, gifted adolescents were less likely than college students to retrieve and use specific instances of Earth fruit (e.g., oranges) and their creations were found to be significantly more original (Ward et al., 1999a,b).

Why should retrieving specific domain exemplars lead to less original products than accessing domain information at more abstract levels? Again the answer may lie in the nature of the stored information. The information stored about specific instances is, by definition, more specific and consequently may be more constraining than more abstract information regarding the same types of properties. For example, the representation of the basic level exemplar "cat" might be expected to include properties such as "two eyes" and "four legs," whereas the more abstract representation of "living thing" might include the parallel properties of "means of sensing the environment" and "means of movement." Assuming that people are equally likely to project properties of the information they retrieve onto their creations, regardless of the abstractness of that information, an individual relying on "cat" would be more likely than one relying on "living thing" to imagine an extraterrestrial that had eyes and legs, which in turn would lead to lower judged originality. The more abstract "living thing" representation would afford a greater range of possibilities (beyond eyes and legs) for implementing the general idea that creatures should have some way of sensing their environment and moving around.

It is important to note, however, that there is nothing wrong, in principle, with the approach of retrieving a specific known instance of a category or a specific previous problem solution as way of gaining some purchase on a new problem. Indeed, there may be circumstances under which it is preferable to a more abstract approach. For one thing, it can be highly efficient and lead to the rapid development of new products. If a perfectly good model already exists, then using and modifying it only slightly may be the most expedient and appropriate course of action, as in the near analogy examples described in the previous section. It might also help to make new products more acceptable to their target audience by keeping them from deviating too far from the familiar. An extraterrestrial that deviated greatly from known Earth animals might not be recognized as an animal at all, and by analogy, a new product that

deviated too greatly from other members of its product class might not be accepted by consumers at all.

The problems associated with patterning new ideas directly on specific old ones become apparent primarily when irrelevant, unnecessary properties of the old ideas are retained in the new ideas and result in either delayed development or flawed designs, as in the CD and passenger car examples noted earlier. The argument being made here is that a more abstract approach might have helped in those types of situations. It might also be expected to contribute to the success of business ventures, at least under some circumstances. For example, an idea to improve on existing kennels might lead an innovator to add new features to a basic kennel structure, but a consideration of more abstract ideas about why people use kennels (e.g., to provide a safe and comfortable environment for pets while on vacation) might lead to a new venture altogether (e.g., a service that makes "house calls" and cares for pets in the owner's home).

6. A broader perspective

There is little doubt that creativity is a complex enough phenomenon that the structures and processes underlying novel idea generation will not be enough to explain it fully (e.g., contributions to Sternberg, 1999). Clearly, interactive models that include knowledge, cognitive processes and skills, motivation, personality factors, and environmental influences are needed to provide a complete theoretical account (e.g., Amabile, 1983; Sternberg and Lubart, 1991). This is no less true for entrepreneurial creativity than for artistic or scientific creativity. If we view successful entrepreneurs as those "individuals who identify opportunities and start new companies to develop them" (Baron, 2000, p. 15), then they will need to be able to do more than simply generate useful new ideas. Likewise, if we view entrepreneurial creativity as "the generation and implementation of novel, appropriate ideas to establish a new venture" (Amabile, 1997, p. 20), then a range of internal and external factors become relevant to the task.

It is one thing, for example, to envision some desirable new Internet application and quite another to implement the idea, convince others that it is worth pursuing, and then market the application successfully. In addition to being able to generate ideas and recognize good ones when they see them, entrepreneurs presumably ought to have high levels of intrinsic motivation, belief enough in their ideas to push them even in the face of negative feedback, at least some expectation of external rewards, and a capacity to persuade others of their worth. They need the requisite ingredients to invest in ideas that are currently unknown, unpopular, or otherwise low in value and to develop and sell those ideas to others at a higher value as in Sternberg and Lubart's (1991) investment model.

By focusing more narrowly on cognitive structures and processes, the intent of this paper is not to diminish the importance of other factors. It is simply to draw attention to constructs from mainstream cognitive psychology and how those constructs can be applied to an important component of the entrepreneur's task, namely, the generation and exploitation of novel and useful ideas. It is clear that knowledge plays a paradoxical role in creative endeavors. It supplies the raw materials from which creative new ideas are forged, but also

carries with it the potential to inhibit creativity. By careful application of a variety of basic cognitive processes, it is possible to put knowledge to more effective use and improve entrepreneurial creativity.

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