Papers

Human Development 1991;34:1–31

0018–716X/91/0341–0001$2.75/0

An Investment Theory of Creativity and Its Development

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Key Words. Creativity · Development · Environment · Intellectual style · Intelligence · Investment · Knowledge · Motivation · Personality

Abstract. This article presents an investment theory of creativity. The theory comprises 6 resources for creativity – intellectual processes, knowledge, intellectual style, personality, motivation, and environmental context. Creative performance results from a confluence of these elements. Main features of each resource are explained and the manner in which the 6 resources combine is discussed. Then a preliminary empirical study that tests aspects of the investment theory is briefly presented. Next, the development of creativity in terms of the 6 resources is described. Finally, potential criticisms of the investment theory are addressed. The goal of the theory is to understand in a cohesive way the foundations of creativity. To the extent that true creativity seems rare, it may be because many people are not willing to invest in it and because so many resources must converge in order to generate it.

Consider the relationship between two very different spheres of discourse, investment and creativity. The most obvious and even trivial advice that one can give an investor in the financial markets is to 'buy low and sell high'. Yet, few people follow this advice [Dreman, 1982]. Successful investors have to be bold, willing to take risks, and ready to act contrary to the behavior of other investors. When they buy an out-of-favor stock or other financial instrument, they may be seen as foolish. But if that financial instrument comes to be widely recognized as a good investment, its price rises rapidly, and it is no longer possible to buy it at a low and hence favorable price. The person formerly seen as foolish may now be seen as prescient.

An analogous situation can be observed for creative performance. A person who jumps on a bandwagon and produces work that is already in vogue and similar to that of others may be viewed as competent, but not as creative. In effect, the 'price' of that kind of work is already high. In contrast, an individual who generates and advances a new idea in science or a new style in art may originally be seen as out-of-touch or even as fool-

ish. But if others come to recognize the value of that work, the individual will be seen as highly creative. Of course, creativity is not an all-or-none phenomenon. There is a continuum of creative performance, just as there is a continuum of profits across investments.

The parallel between creative endeavor and financial investment can be further developed. Take, for example, the field of science. Kuhn [1970] has observed that most scientists work within an established theoretical or methodological paradigm. Occasionally, revolutionary scientists shift the way others think about the world, resolve inconsistencies in earlier theories, and raise new questions to be addressed. Thus, Copernicus revolutionized astronomy by shifting from a geocentric to a heliocentric view of the solar system. Einstein shifted long-held theories of mass, energy, and light to a framework of relativity. Scientists who create paradigm shifts 'buy low', advocating new and initially strange or unpopular ideas, and then are able to 'sell high', often moving on to the next problem when others have bought into their point of view on the first problem. Most scientists – what Kuhn calls 'normal scientists' – prefer to work with existing ideas that are already fairly well developed and accepted. They 'buy high' into ideas that may have less upside potential, precisely because the ideas are already popular and hence no longer original.

Neither the financial nor the creative worlds are limited to the well-heeled or high-stakes individual. In the financial world, there are both large- and small-scale investors. We often think of creativity in terms of the discoveries of great scientists, the paintings of great artists, and the novels of great writers. But, as the investment metaphor suggests, creativity is exhibited by more than the rarefied fraction of the population who engage in high-level pursuits. Creativity can be found in our daily lives.

The investment perspective highlights the critical role of topic selection in creative performance. Finding potential avenues for creativity is nontrivial, just as, to a large extent, success with financial instruments depends on the choice among investment options; all stocks that are low do not have high growth potential. For creative performance in art, as an example, Getzels and Csikszentmihalyi [1976] found that the most creative artists are those who exhibit taste in their choice of problems for visual expression. And Zuckerman [1983] has highlighted the importance of taste in scientific problems as an important determinant of creativity in science.

Creativity and investment are not strictly analogous. For example, after topic selection, creators must work personally to realize the novel idea that has been chosen as a focus. Investors do not have to do so. To render investment and creativity more strictly analogous, investors would need to go to work for the company in which they had invested financially, in order to make their investment succeed. Creative people invest themselves in their projects to yield the 'value added' on their initial idea. For example, an artist may conceive of a new painting style and then exhibit this style in tangible work for others to see. Eventually, this work may be evaluated as creative.

When evaluating financial investments, the measurement of performance is clear, namely, monetary gain. An investor who has good ideas but does not participate in the stock market is not a successful investor. In our view of creativity, a similar distinction exists between latent creative potential and

creative performance. Our theory focuses on creative performance – creativity that is manifested in an overt form.

Given a substantive product, such as an artist's painting, the evaluation of creativity can proceed. In a fundamental sense, evaluation of both financial worth and creativity is based on social consensus. A stock is valuable because investors collectively desire to possess it, and a product is creative because appropriate judges collectively agree on this evaluation [Amabile, 1982a]. Previous theoretical and empirical accounts of people's conceptions of creativity suggest novelty or statistical rarity, appropriateness, and high quality as the main criteria for judging creative performance [Amabile, 1982a; Jackson & Messick, 1965; MacKinnon, 1962; Sternberg, 1985a, 1988a]. Evaluation of a creative performance furthermore depends on the characteristics of the judges and the set of products available to the judges at a given point in time. Sometimes, the value of either a company (as represented by its stock price) or of a creative product is not initially seen by judges. It may take months or even years before the value of the company, or the creative product, is fully recognized by the society at large.

Before proceeding, we should qualify the investment metaphor. The metaphor may be distasteful to some readers, leading them to believe that we view creativity as a 'money-making' enterprise. Some may see financial concerns as antithetical to creativity. But readers should remember that we make investments of many different kinds, only one of which is financial. The concept of investment is by no means limited to the financial domain. In a broad sense, people constantly invest time, effort, and emotional energy in careers or interpersonal relationships. Moreover, as Gentner [1983] has pointed out, analogies are between structures relating two domains, without regard to the content of those domains. Thus our theory makes structural parallels, not content ones. For consistency, however, we concentrate on financial investment in references to the investment metaphor.

Resources for Creativity

What kinds of resources lead to success in the 'creativity marketplace'? Much theory and research have been addressed to the antecedents of creative performance. Researchers often have postulated a unitary source of creativity or focused on one determinant of creativity to the exclusion of others. For example, several psychoanalytic formulations locate creativity in the ability to regress or access preconscious primary-process thinking and synthesize it with conscious, secondary-process thought [Arieti, 1976; Kris, 1952; Kubie, 1958; Maslow, 1968; Suler, 1980]. Mednick [1962] and, recently, Findlay and Lumsden [1988] focus on the cognitive, associative basis of creativity. Guilford [1967] proposes divergent thinking abilities as the crux of creativity, and Schank [1988] concentrates on a creative attitude. Another approach has focused on the strong effect of the environment on creativity [Kroeber, 1944; Simonton, 1975].

While the utility of a multivariate approach to creativity has been suggested [Arieti, 1976; Dellas and Gaier, 1970], few theories have truly incorporated the idea. In areas related to creativity, Tannenbaum [1983] has proposed general ability, special ability, nonintellective variables, the environment and chance as 5 giftedness factors

that 'mesh into excellence'. For the development of child prodigies, Feldman [1986, 1988] identifies the coincidence of beneficial conditions as the causal factor. Csikszentmihalyi [1988] advances a view of creativity as a function of person, field, and domain systems that affect each other. Amabile [1983a,b] has also proposed a componential model describing creativity as the result of motivation, domain-relevant skills, and creativity-relevant skills. Intrinsic motivation – motivation deriving from within the individual rather than from the desire for extrinsic rewards – is the most important component in her theory. Domain-relevant skills refer to knowledge and abilities pertinent to the task at hand. The creativity-relevant skills component consists of (a) 'a *cognitive style* characterized by a facility in understanding complexities and an ability to break set during problem-solving', (b) '*knowledge of heuristics* for generating novel ideas' such as trying a counterintuitive approach, and (c) a *work style* that is characterized by concentrated effort, an ability to set aside problems temporarily, persistence, and high energy. Personality characteristics, such as independence, are also discussed under creativity-relevant skills [Amabile, 1983b, pp. 72–74].

The investment theory that we propose differs from previous theories in the conceptualization of the resources important to creativity and in the proposed nature of their interaction. In particular, with regard to Amabile's model, the creativity-relevant skills component can be criticized as a catch-all category. The theory we propose is a 'knitted' one [Kalmar and Sternberg, 1988], in the sense that it draws together a number of ideas currently in the literature on creativity. Some of the ideas that have played an important role in the development of our thinking are Amabile's [1983a,b] componential model of creativity, Barron's [1969] and MacKinnon's [1965] ideas about the role of personality in creativity, Csikszentmihalyi's [1988] systems approach, Getzels and Csikszentmihalyi's [1976] ideas about problem-finding, Gordon's [1961] synectics model, Kirton's [1976] ideas about creative styles, Simonton's [1984, 1988a] ideas about environmental and historical determinants of creativity, and Walberg's [1988] ideas about creativity and human capital. We also draw heavily on Sternberg's [1985b] triarchic theory of human intelligence and theory of mental self-government in intellectual styles [Sternberg, 1988b]. We believe, however, that our new synthesis in terms of an investment metaphor incorporating 6 resources is fairly comprehensive and goes at least somewhat beyond existing work.

The structure of the investment theory is shown in figure 1. An understanding of creativity takes place at 4 levels – resources, abilities, projects, and evaluations. Underlying creativity are 6 basic resources: (a) processes of intelligence and the mental representation upon which they act, (b) knowledge, (c) intellectual styles, (d) personality, (e) motivation, and (f) environmental context. Obviously, not all aspects of each resource are relevant for creativity. Rather, only selective aspects are important. From an investment perspective, these 6 resources are viewed as the income stream that can be channeled into creative performances. In order for these resources to be used effectively, they must converge in a way that capitalizes upon them both singly and in interaction. For example, high intelligence in the absence of motivation, or extensive knowlege in the absence of the intellectual ability to under-

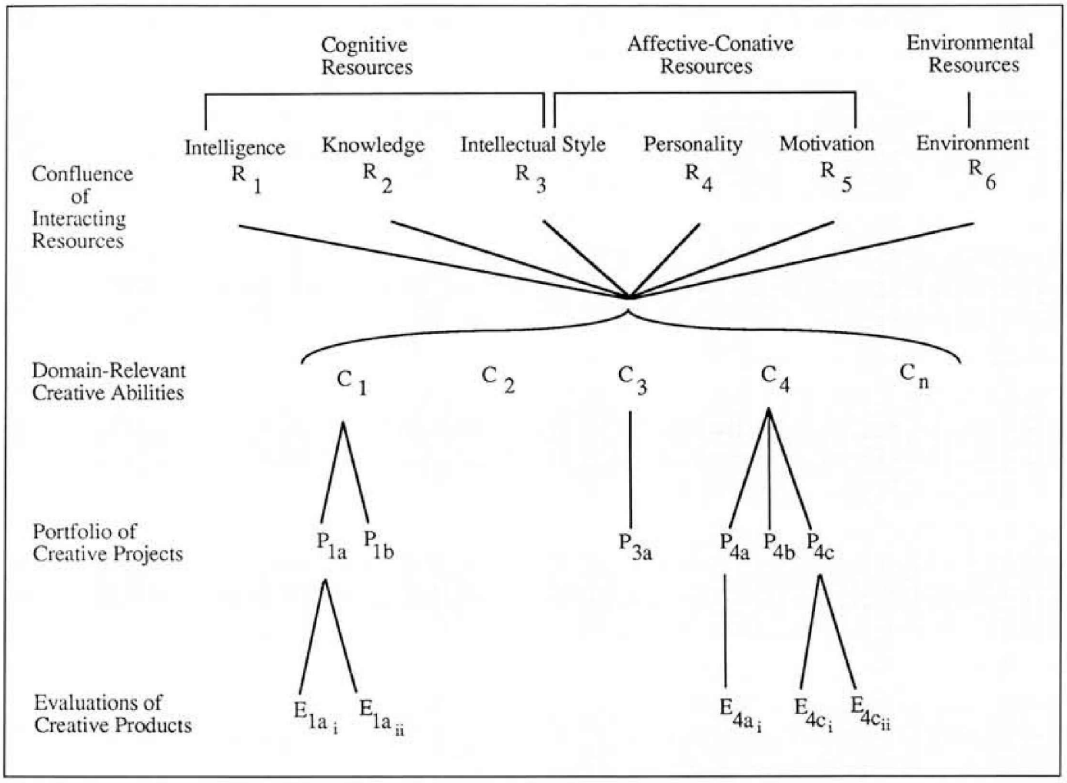

Fig. 1. Six resources (R) converge in an interactive manner to generate various domain-relevant creative abilities (C), which are partially overlapping (neither wholly domain-specific nor wholly domain-general). Some of these abilities, in turn, generate a portfolio of creative projects (P). These projects yield products that are in turn evaluated (E), sometimes multiply. We can measure creativity only through these evaluations, which can fluctuate with the persons doing the evaluations and with the spatiotemporal context of the evaluations.

stand and utilize that knowledge, will lead to, at most, modest levels of creative performance. Thus, the resources should be viewed in confluence, not simply in isolation.

The resources are neither entirely domain-general nor domain-specific; rather, they vary. Some abilities may be general, others rather domain-specific [Sternberg, 1985b]. Similarly, a personality attribute such as risk-taking may apply to some domains more than others. Thus, the resources will converge in complex ways (that are empirically identifiable) to produce domain-relevant creative abilities, which will probably exhibit at least a weak degree of interrelationship. The weak interrelationship will derive from similarities across domains in the strength of the ideal contribution of each of the 6 resources. According to this view, then, creativity does not stem from some single, general ability, nor from a totally domain-specific ability, but rather from a confluence of resources, with differential contributions across domains.

An individual may attempt creative projects in any number of domains, up from zero to the (unspecified) numbers of domains in which such abilities exist. Figure 1 shows, as an example, an individual who has attempted 2 creative projects in domain 1, 1 creative project in domain 3, and 3 creative projects in domain 4. The choice of creative projects is guided, in general, by the desire to 'buy low and sell high' – to choose projects in domains or using paradigms that are at least slightly out of favor, but that have growth potential. In other words, the projects are ones that have the potential to spark interest among members of potential audiences. Optimal portfolios of creative projects are those that balance risk with diversification. At least some of the projects will be risky, but probably not all. And by undertaking a variety of projects, the risks of single projects are spread out. The interacting resources contribute not only to the projects themselves, but to the choice of these particular projects.

Ultimately, some of the products of creative endeavors are likely to be evaluated. In figure 1, the outcome of project 1_a is evaluated by 2 individuals, the outcome of project 4_a is evaluated by just 1 individual, and the outcome of project 4_c is evaluated by 2 individuals. Evaluations will depend upon the interaction of the product, the individual doing the evaluating, and the context in which the evaluation is done. In general, we expect some degree of consensus in judgments of creativity [Amabile, 1982a], although the consensus will be imperfect because each rater will be coming from a slightly different context with values that are likely to differ at least somewhat. Evaluations of a given product, then, may differ across time and place. Our judgments of creativity will depend upon these evaluations and therefore may not always be the same.

A detailed description of the resources and a discussion of their confluence are now presented. A preliminary study of the investment theory is then described. Next, developmental issues of creativity are discussed in terms of the 6 resources. Finally, two potential criticisms of the investment theory are addressed.

Processes of Intelligence

Intelligence consists in part of a set of mental processes used for the input, transformation, and output of information [Sternberg, 1977]. The processes of intelligence described here as relevant to creativity are drawn from Sternberg's [1985b] triarchic theory of human intelligence. In the triarchic theory, intelligence is viewed as comprising three aspects: the components of intelligence, the level of experience to which these components are applied, and the context in which the components are applied to experience. Each of these three aspects of intelligence has some relevance to creativity.

There are three kinds of information-processing components of intelligence: metacomponents, used to plan, monitor, and evaluate strategies for solving problems; performance components, used to solve the problems; and knowledge-acquisition components, used to learn how to solve the problems. Creativity involves the application of these processing components to relatively novel kinds of tasks or situations, or the application of these components to a familiar task or situation in a novel way in order to adapt to, select, or, most importantly,

shape the environment. Consider how the interaction between components, experience, and context can take place.

Defining and Redefining Problems

In the world of business and investment, a customer's needs are an entrepreneur's opportunities. In business, art, or science, creativity can result from the definition or redefinition of a problem [Mackworth, 1965]. A problem that is originally ill-defined or conceived in a particular way is recast in another way. For example, Chomsky reconceived the nature of language, arguing that it could be successfully understood in terms of surface and deep structures rather than merely in terms of phrase structures. Indeed, great people in a variety of fields, including artists (such as Monet or Picasso) and writers (such as Chaucer or Hemingway), are considered great in part because they reshaped their fields in ways that represent redefinitions of problems.

Many highly creative individuals express their creativity by bringing the knowledge and procedures of one field into another, thereby redefining the problems of their major field in terms of problems of a different one. For example, Miller integrated linguistics with psychology, Simon integrated computer science with psychology, and Piaget integrated aspects of philosophy and biology with psychology.

Redefinitions of problems can occur at any level of creativity. Consider a true case of problem redefinition from daily life. A man loved his job and made a lot of money, but he could not stand his boss. He considered quitting his job and went to a 'head-hunter' to find a new job. It then occurred to him that the problem could be reconceptualized. He went back to the head-hunter and asked the head-hunter to find his boss a new job, which the boss accepted. This solution involved a novel and appropriate redefinition of the problem as one of removing the boss, rather than oneself.

Empirically, Sternberg [1982] found that the ability to transfer between conventional and unconventional conceptual systems is related to fluid and insightful reasoning abilities. Thinkers who coped well with novelty could think in conventional terms, such as in terms of objects being 'green' or 'blue', but could also transit easily to thinking in unconventional terms, such as in terms of objects being 'grue' – green until the year 2000 and blue thereafter – or 'bleen' – blue until the year 2000 and green thereafter [Goodman, 1955]. Getzels and Csikszentmihalyi [1976] provide a more direct link between problem definition and creativity in their study of artists. Artists whose work was judged to be more original and who achieved greater success spent more time formulating their experimental art compositions. In particular, the amount of manipulation and exploration of objects available for the artist's compositions and a redefinition in the treatment of a still life away from a traditional view related positively and significantly to originality in the final works [Csikszentmihalyi and Getzels, 1971].

Insights

How does one go about redefining and solving problems creatively? In other words, what kinds of mental processes might help a person to reconceptualize a problem in a new way? Davidson and Sternberg [1984; Sternberg and Davidson, 1982] have proposed that selective encoding, selective comparison, and selective combination processes can facilitate seeing old problems in new

ways, seeing new problems in old ways, and solving these problems.

Selective encoding is the noticing of potentially relevant information for the conceptualization or solution of a problem from amidst a stream of information. The stock market is itself often described as 'information-efficient' [Malkiel, 1985], because new information about companies or world conditions is encoded very rapidly and selectively by investors. But the most successful investors often find and can see the relevance of information that others do not see or ignore. A good selective encoder is an individual who can pull from the endless stream of incoming information that which he or she needs in order to deal with the task at hand. For example, Freud [1965] was an exceptionally able selective encoder. Many people before him undoubtedly had treated patients similar to the ones he treated, but Freud noticed things about the patients that might have passed others by. Similarly, in observing his own children Piaget noticed behaviors that others undoubtedly had looked at but not truly 'seen' [Gruber and Vonèche, 1977]. Selective encoding can occur in any domain. In art, Rembrandt's observations of light, Lorrain's noticing of the natural beauty of landscapes, Gaugin's noticing of the sensuality of Tahitian women, and Braque's attention to the formal structure of objects all constitute excellent examples of selective encoding. In the world of common experience, inventions as mundane as toilet paper, light bulbs, ballpoint pens, and magnets originated when people recognized a need for a product that was at the time unavailable.

In two experiments, Glover [1979] found that the kind of information that highly creative people seek about problems is qualitatively different from the information encoded by less creative people. Low-creative subjects, as defined by the Torrance Test of Creative Thinking, tended to ask factual knowledge and comprehension questions while high-creative subjects tended to ask evaluative, synthetic, and application questions [see also Lembright and Yamamoto, 1965].

Selective comparison, the second insight process, involves the perception of an analogy between the old and the new. When so-called 'technical analysts' – those who use past market performance to predict future market performance – look for trends in financial markets, they are performing a selective comparison between states of a market at different points in time. There are numerous cases of analogy leading to creative insights [Dreistadt, 1968]. For example, Kekulé's discovery of the structure of benzene was allegedly based on a selective-comparison insight: Keuklé dreamed of a snake dancing around and biting its tail, and realized that the dream constituted a visual image of the structure of benzene, namely, a ring. Divergent thinking skills [Guilford, 1967] and the ability to make remote associations between topics [Mednick, 1962] can be seen as different aspects of the selective-comparison component. A large body of empirical literature, reviewed in part by Barron and Harrington [1981], supports the importance of divergent and associational abilities for creativity.

The third kind of insight is *selective combination.* When investing, information about diverse aspects of a company's performance needs to be put together in an effective way to decide whether the company is one whose stock will potentially increase in value. When creating, disparate pieces of information need to be put together in a novel and

useful way. A concrete example is the formulation of a creative recipe. With guests coming, the cook has to figure out how to make a good-tasting dish out of the available ingredients. Rothenberg [1979a] has distinguished a kind of selective combination that he calls 'Janusian thinking', after the Roman god Janus, whose several faces simultaneously had opposite views of the world. Janusian thinking is the simultaneous integration of opposite or antithetical thoughts. Through intensive case studies of eminent creators and experiments, Rothenberg has linked integrative thinking to creativity. In particular, analysis of Einstein's sequence of thoughts leading to the general theory of relativity, and a study of Bohr's thoughts on particles, waves, and the complementarity principle for light, demonstrate the use of selective combination in creative scientific thinking [Rothenberg, 1979b, 1983]. In a retrospective report of his thinking, Einstein wrote:

> Just as in the case where an electric field is produced by electromagnetic induction, the gravitational field similarly has only a relative existence. *Thus, for an observer in free fall from the roof of a house there exists, during his fall, no gravitational field* [italics in original; Rothenberg, 1979b, p. 39].

We can see in this brief passage the selective comparison of electric and gravitational fields, and then selective combination of mundane experience with relativity, yielding what Einstein described as the happiest thought of his life.

Knowledge

In order to be creative within a given area of endeavor, one has to know something about that area. One needs to know where things are, what has been done, and what needs to be done, how one can go about creating what is needed, and how one's ideas will be perceived by other people, either in a specific field or in general. Lack of knowledge in a field can lead a person to creative reinvention. To an informed group of judges, however, the product of reinvention is not a novel, creative contribution to the field. Truly creative work is almost always done by people who are, at least to some degree, 'in the know'. Conventional paper-and-pencil tests of creativity, such as the Torrance [1974] test, may be of only limited value because, to the extent that they assess creativity at all, they do so in a knowledge-poor rather than a knowledge-rich environment [Sternberg, 1988a].

The role of knowledge in creative performance can be illustrated in the realm of stock-market investing. In general, those who do the best are contrarian – they go against the market [Dreman, 1982]. Contrarians lead the pack of investors by buying a stock before it becomes popular and high-priced. But in order to go against the market, these innovative investors have to know where the market is. In short, creativity in a well-developed area is likely to require some prerequisite knowledge of what is going on in that area, but also the ability to free oneself of the confines of that knowledge.

Many have observed that those people with the most knowledge or experience in a given area of endeavor often do not produce the most creative work in that area. In fact, when formal education is taken as a measure of knowledge, an inverted-U function for creativity is demonstrated [Simonton, 1984]. Simonton [1983] analyzed historical data on 192 creative geniuses. He found increases in knowledge through the college-

level to be positively related to creativity. However, further education slowly became detrimental for creativity. This turning point may occur slightly earlier or later, depending on the discipline.

Mednick [1962] offers a memory-based explanation for the described relationship between knowledge and creativity. More knowledge is beneficial, in one respect, because a person's associative network becomes fuller. To use Mednick's [1962, p. 222] example, an architect who does not know of the existence of a new material can hardly be expected to use it creatively. However, as a person develops and refines knowledge in a particular domain, finer distinctions are made. The associations become narrower and more organized. For example, the term 'reaction time' will probably elicit a wider range of associations of more equivalent strengths from an introductory psychology student than from a perception researcher. It is the flat, diffuse associational network that is more likely to allow remote associations to occur. These remote associations can bring a new, creative point of view to a problem. Hence, there can be a trade-off between completeness of knowledge and the ability to find creative associations within that knowledge base.

Another, related explanation of the potentially inverted-U relationship between level of the knowledge resource and creativity lies in the trade-off between proceduralization and flexibility [Sternberg and Frensch, 1989]. This trade-off can occur when knowledge and expertise are acquired. A main advantage that experts have over novices is that they have learned and often automatized a large number of task-related procedures. In terms of our investment metaphor, tasks that require substantial processing resources from novices may require trivial investments of processing resources from experts. The experts are thereby freed to direct their spare processing resources to sources of novelty. But the increased proceduralization of the experts may come at the cost of flexibility. In Langer's [1978, 1989] terminology, experts essentially can become mindless by applying standard solutions to tasks. Because the experts have a ready-made way of viewing problems, they may have trouble seeing problems in a different way and become victims of set effects [Luchins, 1942].

Frensch and Sternberg [1989; Sternberg and Frensch, 1989] investigated the proceduralization-flexibility trade-off in a series of experiments comparing experts and novices at the game of bridge. Experts and novices were given bridge-related tasks that were either true to the game of bridge, induced surface-structural change, or induced deep-structural change. The surface-structural manipulations involved changes in the names of suits (spade, heart, diamond, club to pular, biref, ramog, kamer) or changes in the order in which the suits were ranked. The deep-structural change involved an alteration in the basic strategy of the game, such that the player putting down the lowest ranked card now led bidding in the subsequent round. Experts were substantially more affected by the deep-structural change than were novices, whereas they were not more affected by the surface-structural change. Experts seem to lose flexibility primarily as a result of fundamental changes in the structure of what they are doing. Experts, it appears, need to find in their careers ways of counteracting the effects of entrenchment. Interacting with graduate students, reading the most recent literature on diverse topics,

attending conventions, and the like, all provide ways of counteracting these effects [Kasperson, 1978].

Intellectual Styles

An intellectual style is a propensity for using one's abilities in a certain way or ways [Kogan, 1973]. A style is not itself an ability, but rather a preferred way of using one's abilities to approach a task or situation. The abilities involved in coping with novelty are an essential part of creativity, but so is the style with which these abilities are applied.

Sternberg's [1988b] theory of intellectual styles provides a basis for describing creativity-relevant styles. This theory treats styles in terms of mental self-government and is logically consistent with the triarchic theory of intelligence, which guided our discussion of creativity and intelligence. Empirically, Sternberg's intellectual styles have shown good convergent validity with other style theories and high discriminant validity with intellectual ability measures [Martin, 1988]. A survey of different functions, levels, and leanings of contemporary governments yields a corresponding set of distinctive intellectual styles. Three functions of government are the legislative, executive, and judicial. In theory, the function of the legislature is to formulate laws and principles of government, the function of the executive is to implement these laws and principles, and the function of the judiciary is to evaluate the extent to which the laws and principles are sound or are followed in particular instances. An individual may have a proclivity toward legislative, executive, or judicial kinds of mental functions, or toward some combination of these functions.

Creative people are most likely to be those who prefer a legislative style, at least in the domain or domains in which they are creative. They are people who like to come up with their own rules, procedures, or ideas. They are the inventors and the discoverers. Similarly, in the investment world, legislative stylists are the creators of investment options, such as 'certified' rare coins or certificates of deposit. Executive stylists like to implement rules or procedures outlined by others. They are the brokers who buy and sell on the market using the investment options designed by others. Judicial stylists like evaluative tasks, such as analyzing trends in the stock market.

Another style variable relevant to creativity is the global vs. local style. Based on levels of governmental operation, a global style is a preference for large, broad problems like those dealt with in the highest levels of government. The local style is a preference for smaller, narrower, detailed aspects of tasks. One can be creative in either a global or a local context. Many everyday situations (and commonly used paper-and-pencil creativity tests) are highly constrained and favor creativity in details. Truly striking levels of creativity, however, are often associated with the global style – with the person who seeks out larger and broader problems [Gruber, 1981]. Both global and local styles can be beneficial to creative performance, depending on the task itself and the stage of work on the task. The ability to move between global and local styles may be most important, with this flexible alternation having the greatest stylistic advantage for creativity.

A third aspect of intellectual style that pertains to creativity is the conservative-progressive leaning of one's mental self-government. A conservative stylist prefers tradi-

tional approaches and maintenance of the status quo. In contrast, a progressive stylist has a novelty-seeking orientation, such that change and innovation are preferred. When investing financially, progressive stylists may have a tendency to choose stocks of small, start-up companies over those of well-known, stable companies. Over the long term, small-company stocks actually do perform better than large-company stocks [Malkiel, 1985]. When investing creatively, progressive stylists should have a clear advantage because they prefer change and positive change is a hallmark of creativity. Empirically, the conservative style is often associated with the executive style and the progressive style with the legislative style. When these style complexes occur, we hypothesize that the relationship of style to creativity will be even stronger.

Other style theories offer convergent evidence for the proposed positive relationships of legislative, global-local, and progressive styles to creativity. For example, in Jung's [1923, Myers and Myers, 1980] theory of types, sensing and intuitive styles of perception are proposed as most relevant to creativity. Sensing types, who are less creative, rely more on external information, focus on 'the realities of a situation, ... work with what is "given", ... They prefer to use proven procedures and are careful with detail.' In contrast, intuitive types, who are more creative, concentrate more on 'meanings, relationships, and possibilities that go beyond the information from [the] senses. Intuitive types look at the big picture and try to grasp the overall patterns' [Consulting Psychologists Press, 1987, p. 2]. The sensing vs. intuitive types show strong theoretical connections to the local-global and conservative-progressive styles of mental self-government. Empirically, creative samples show a strong preference for intuitive thinking [Myers and McCaulley, 1985]. In one study by Hall and MacKinnon [1969], all 40 architects whom peers rated as highly creative showed a preference for the intuitive type of thinking. In a matched control group of architects, only 61% preferred the intuitive type over the sensing type.

Another converging theory of style is Kirton's [1976] distinction between adaptors and innovators. Adaptors seek problem solutions that involve adjustments or incremental modifications while maintaining basic structures. Adaptors work within a paradigm. Innovators seek to restructure fundamental elements, and this concern with fundamental change involves innovators in global aspects of a task. Both adaptors and innovators favor change and can be described as somewhat progressive in terms of Sternberg's conservative vs. progressive style dimension. If adaptors and innovators show equal levels of creativity but differences in the detail orientation of creative performance, as Kirton [1976, 1978] suggests, then Kirton's styles can be mapped onto the local vs. global styles of mental self-government. However, if innovators show a higher level of creativity than adaptors, then the innovator style may also correspond to a stronger progressive style, with adaptors falling closer to the conservative style. In favor of this latter view, several studies have demonstrated moderate correlations between a preference for the innovative style and paper-and-pencil creativity measures [Isaksen and Puccio, 1988; Masten and Caldwell-Colbert, 1987; Mulligan and Martin, 1980; Torrance and Horng, 1980].

To summarize, legislative and progressive styles are beneficial to creativity. Both

global and local styles may enhance creativity, and an ability to shift flexibly between them may be especially beneficial. Alternative theories of intellectual styles provide convergent theoretical and empirical evidence for the proposed relationship of intellectual styles to creativity.

Personality

When people try to understand the behavior of stocks on the market, they often engage in 'fundamental analysis', a study of the attributes of business and the effect of these attributes on stock prices [Malkiel, 1985]. We have taken a similar approach to the large literature on personality and creativity by searching for individual traits that correlate with creativity across studies and then assessing these traits for broad underlying dimensions of personality that are creativity-relevant [Amabile, 1983b; Barron and Harrington, 1981; Dellas and Gaier, 1970; Golann, 1963].

One personality attribute associated with creativity is tolerance of ambiguity [Barron and Harrington, 1981; Golann, 1963]. In most creative endeavors, there is a period of time during which the individual is groping – trying to figure out what the pieces of the puzzles are or how to put them together. During this period, the individual is likely to feel some anxiety, and possibly even alarm, because the pieces are not forming themselves into a creative solution. The creative individual needs to be able to tolerate this ambiguous situation and to wait for the pieces to be balanced, to come together, or to relate to previous knowledge. Often, impulsive and premature closure will result in a solution that is inadequate. For example, in the search for the structure of the DNA molecule, Pauling published a proposed structure prematurely, which proved to be wrong. We should also mention that one of us previously published a paper on the *three* facets of creativity [Sternberg, 1988c], which was an incomplete account. Indeed, there is always a conflict between the possibility of publishing prematurely and the possibility of waiting so long that the value of the contribution is reduced.

A second personality attribute associated with creativity is a willingness to surmount obstacles and persevere [Golann, 1963; Roe, 1952]. Whereas prodigies – children with exceptional talents in a particular domain – tend to grow up under circumstances where practically everything goes right for them, creative adults almost inevitably have experiences where things go wrong. Indeed, it is probably such experiences that in part help them to grow [Feldman, 1986]. Almost every major creative thinker has surmounted obstacles at one time or another, and the willingness not to be derailed is a crucial element of success. Charles Schwab, the leading discount broker in the USA, who virtually invented the concept of discount brokerage, failed in an earlier attempt to form a business. And, of course, Edison tried seemingly innumerable substances for the filament of an incandescent light bulb before he finally tried tungsten, a substance with the needed properties. In a survey of 710 inventors, Rossman [1931] found that perseverance was, in fact, the most frequently mentioned characteristic for success. Creative people need to be willing to surmount the obstacles that inevitably get in their way. And when they fail, they are resilient and bounce back, rather than being mentally or spiritually broken by their failure.

A third personality attribute of creative people is a willingness to grow, an openness to new experiences [McCrae, 1987]. When one has a creative idea early or even in mid-career, there is a great deal of pressure to stay with that idea. For one thing, one receives a lot of reinforcement for the idea and the exposition of it once it has been recognized. Second, the idea often leads to minor spin-offs that can keep one going for large amounts of time. Third, one faces the risk that following up on another idea will result in one's being perceived as on the way down. Due to statistical regression alone, one risks that the next idea will not be as successful as the last one. Finally, in pursuing a new idea, especially if it is in a somewhat different area, one is starting from scratch and is not carrying over into the new field all or perhaps even most of the status that one earned in the old field. But people who remain creative beyond that first idea – who do not turn out to be 'one-idea' persons – are willing to grow and try new things. Similarly, successful investors realize that to remain successful, they need to keep up with the times, rather than fall back on strategies that may have worked at one time but do not continue to work.

The connection between creative individuals and successful investors is most apparent in a fourth personality attribute, willingness to take risks [Glover and Sautter, 1977; McClelland, 1956]. When Glover [1977] explicitly induced risk-taking in groups of students, he found that performance on the Torrance Test of Creative Thinking showed increased flexibility and originality, decreased elaboration, and no change in fluency of response, supporting the risk-taking – creativity link. Creators, like investors, will often balance risks; high-risk projects are pursued simultaneously or in close succession with low-risk ones, so that entire success does not hinge upon the large risk. Thus, creators balance risk with diversification, a balance that characterizes almost all successful investment portfolios [Johnson, 1988].

The fifth of the personality attributes associated with creativity is individuality and a supporting courage of one's convictions [Barron and Harrington, 1981; Dellas and Gaier, 1970; Golann, 1963; MacKinnon, 1962, 1965]. As we noted earlier, successful investors do not follow the pack, they lead it. A consistent finding in the personality and creativity literatures is that creative people are not slaves to the social norms. In group conformity experiments, subjects rated higher on creativity show less tendency to yield their individual opinions to group norms [Crutchfield, 1962]. They have an internal locus of evaluation and take pride in being unique and distinctive. A courage of convictions must accompany individuality, because a creative contribution will often be challenged as deviant or threatening to the status quo. The person who backs down too easily is unlikely to be able to sustain creative enterprise. At the same time, the creative person needs to know when the time has come to back down and to be ready to grow by moving beyond where he or she has been.

Motivation

The motivational resource deals with the driving forces behind creative performance. Possession of intellectual ability, knowledge, and certain intellectual styles that favor creative performance are not sufficient for creative performance. There must also be motivation to use these resources.

Money, an extrinsic reward, may be the most important motivator to a financial investor. In contrast, intrinsic rewards such as achievement of one's potential have often been viewed as most important to creators [Amabile, 1983b; Crutchfield, 1962; Golann, 1962]. While a parallel mapping between investment motivators and creativity motivators is clearly invalid, we have found that the investment metaphor does suggest reexamination and revision of the traditional intrinsic motivation-creativity link. According to Hennessey and Amabile [1988, p. 13],

> persons who engage in activities because of their *own* interest or personal sense of satisfaction and fulfillment are intrinsically motivated, whereas persons who engage in activities to achieve some goal *external* to task engagement are extrinsically motivated.

In more succinct statements, intrinsic motivation has been described as the 'motivation to engage in an activity for its own sake' [Amabile, 1982b, p. 573]. Our investment perspective highlights the fact that intrinsic motivators (e.g., personal satisfaction) are themselves goals; a task can be the vehicle for achieving these goals. [See Deci, 1975, White, 1959, for further clarification of this issue.] To engage in a task 'for its own sake' suggests the unparsimonious view that there are as many motivators as there are interesting tasks. Is there a special poem-writing motivation? Furthermore, extrinsic motivators, like fame, do not always negate creative accomplishment [Amabile, 1988]. In Watson and Crick's work on the DNA molecule, the possibility of fame did not override their focus on the research. The extrinsic motivation intensified their efforts [Watson, 1968].

The important motivation for creativity is *task-focused* motivation. Focusing attention on the desired *goals*, either intrinsic or extrinsic, will be a detrimental form of motivation [Simon, 1967]. As Crutchfield [1962] points out, a desire for self-expression, which may be regarded as an intrinsic motivator, can be detrimental to creativity if the desire becomes too explicit, too consciously apparent. In our view, intrinsic motivators do have a special status because they often lead to a task-focused orientation. In particular, the motivations to achieve competence in one's endeavors [White, 1959], to achieve excellence [McClelland et al., 1953], to self-actualize one's potential [Golann, 1962; Rogers, 1954], to impose a self-created order [Barron, 1963], or to satisfy a desire for intellectual novelty [Berg and Sternberg, 1985; Bornstein and Sigman, 1986], are posited to focus the individual's attention on the task. Compared to extrinsic motivators, intrinsic motivators may lead to a task focus because they are less consciously salient or are perceived as more integrated with task completion. The physical salience of extrinsic motivators leads them often to produce a goal-focused mind-set.

Much of the research on intrinsic-extrinsic motivation and creativity can be reinterpreted as evidence supporting our task- versus goal-focused hypothesis. Research within an 'overjustification' paradigm indicates that increasing the focus on extrinsic goals will undermine subsequent interest in task engagement [Lepper et al., 1973]. Specifically, subjects who perform a task for a reward are found to be less creative than subjects who receive no reward, or a noncontingent reward [Amabile, 1982b; Amabile et al., 1986]. The contingent link between a task and a reward may lead to a goal focus and therefore to decreased attention to the task itself. In another study, Amabile [1985]

made motivating goals like money and job advancement salient to a group of active writers. Compared with a control group, these writers produced less creative poems. A third group of writers, who concentrated on intrinsic motivators, did not differ in creativity from the control group. This result may be due to weakness in the intrinsic-motivation manipulation or to a ceiling effect (if the subjects were naturally highly intrinsically motivated). If the intrinsic-motivation manipulation could make these motivators highly salient, our task-focused hypothesis would predict that the concentration on intrinsic *goals* would lead to a decrease in creativity. The traditional intrinsic motivation-creativity hypothesis, in contrast, would predict enhancement of creativity by heavy concentration on intrinsic goals.

Environmental Context

Neither creativity nor investment can be viewed outside an environmental context. In financial markets, a bull- or bear-market Zeitgeist can affect the overall level of investment activity as well as when and what to buy. Also, economic indicators, such as a low inflation rate or world events, affect investors' behavior. The role of context is relevant to the creative enterprise in three different ways.

First, the environmental context can spark ideas. Some environments provide the bases for lots of creative sparks, whereas other environments may provide the bases for none at all. In support of this idea, Ward [1969] has found that children who take a creativity test in a room full of objects show more ideational fluency than those tested in a bare room. This effect of physical context only occurs, however, when the environment is given attention. In a similar vein, Amabile and Gitomer [1984] found that a group of young children who had a choice of collage material was more creative than a matched group that had no choice of materials. An advantage of an environment containing creative and enterprising people is that one is more likely to have creative ideas sparked by one's interaction with these creative others. This effect is, in part, the justification for brainstorming groups in industries, such as advertising [Moriarty and Vandenbergh, 1984; Osborn, 1963].

Second, the environment is important because it provides a context in which creative ideas are nourished or suppressed. Janis [1972] describes multiple cases of political decision-making in which creativity of group members was actively suppressed because it interfered with the evolution of a group norm. The same phenomenon occurs in business, schools, and other settings. Among 25 children aged 4–5.5, an inverse relationship ($r = -0.6$) was obtained between creativity test performance and parental authoritarianism [Bayard de Volo and Fiebert, 1977]. Experimentally manipulating the limits set in an environment, Koestner et al. [1984] demonstrated a decrement in the creativity of elementary school children's paintings when controlling limits were set, compared with no limits or mere information on limits.

Heath [1983] compared three communities in terms of conditions of language development. She found that children in Gateway, a middle-class white community, were encouraged to be creative in their storytelling, but were discouraged from being creative in embellishing their recounting of sup-

posedly factual events that had happened in their lives. In Roadville, a lower-class white community, children were discouraged from embellishment in virtually all contexts, because it was considered lying. In Trackton, the lower-class black children were rewarded for creative embellishment in all situations. It was expected that they would creatively (and by some standards, dishonestly) embellish stories and events. In other words, each community had a different idea of the border between creativity and lying, and each provided a different environment in which the development of creativity would be socialized.

At a societal level, political fragmentation, governmental instability, and physical proximity to large cultural centers have been taken as measures of cultural diversity and show a positive influence on creativity [Csikszentmihalyi, 1988; Naroll et al., 1971; Simonton, 1975]. Variation in cultural levels of conformity and discipline also exist and can be linked to creativity [Aviram and Milgram, 1977; Lubart, 1990].

A third way in which environmental context is relevant to creativity is in the evaluation of ideas. Creativity is subjectively evaluated and, thus, the rated creativity of a product may differ from one environment to another. For example, a purple tree drawn by an elementary school student might be viewed in one environment as a creative picture and in another as the work of a demented mind. Fields can vary in the stringency of creativity criteria or the extent to which evaluations of creativity are restricted to an elite group of judges [Csikszentmihalyi, 1988]. Across cultures, fundamental differences in the definition of creativity can be found [Lubart, 1990]. The novelty-based, product-oriented Western view of creativity can be contrasted with an Eastern view in which the focus on originality and products is decreased. From the Eastern perspective, creativity involves the reactivation of traditional ideas and, as in self-actualization theories, the person and product are not separable.

The Confluence of Resources

Creativity in a domain might be viewed as a weighted sum of the 6 resources: Because each resource is posited to have a positive causal effect on creative performance, one might assume that the greater the level displayed on each resource, the more creative a person will be. For instance, if two people possess identical levels of a legislative intellectual style and selective-encoding skills, the person with more of a third resource, such as task-focused motivation, will be more creative.

Although many descriptions of creativity implicitly reflect a simple additive model, we suggest that the unqualified additive model described above is unsatisfactory for two reasons. The first reason is the ability of strong resources to compensate for weak resources. For example, a high level of the motivational resource may counteract a poor environmental context. However, a high level of one resource cannot always compensate for a low level of another resource. For example, no level of performance of relevant intellectual processes will fully compensate for a person who is unwilling to take risks or who is inextricably bound to social norms. Similarly, an investor who is unwilling to take prudent risks is unlikely to show great investment gains, no matter how well he or she understands the market. The rule of compensation does not hold in all cases.

The second problem with the additive model concerns the idea that creative performance increases as possession of a resource increases. The knowledge resource, for instance, does not always follow this rule. Although a certain level of knowledge is necessary for a person to operate in a domain and to advance its frontiers, a rigidity of perspective can be a concomitant of high levels of knowledge. Personality and intellectual style characteristics in extreme forms may also become detrimental to creativity. For example, a person who is highly legislative but not at all judicial may have a lot of ideas, but not assess which are his or her good ones and which the bad ones. In other words, more of a resource is not always better. Similarly, it is the mix of investments in a portfolio that determines its ultimate performance.

The investment theory attempts to address the issues raised above and to capture the diverse and interactive ways in which creativity results from the 6 resources. Each resource is hypothesized to contribute uniquely to the level of a person's creative performance. In addition, certain resources in combination interact to further enhance creativity. For example, a legislative intellectual style, coupled with intellectual processes of selective encoding, comparison, and combination, are predicted to increase creativity in a multiplicative fashion. A similar interaction is predicted between personality and motivation. The willingness to grow and to surmount obstacles together with a task-oriented motivation ought to be another beneficial combination.

Every person can be described by a profile consisting of some level of each of the 6 resources. Each resource can itself be described by a creativity function. For knowledge, intellectual style, personality, and motivation, an inverted-U function is predicted between the level of the resource and the resource's contribution to creative performance. In other words, there is an optimal level for these resources, beyond which creativity may suffer. Intellectual processes and environmental context may yield increases in creative performance up to a point, beyond which higher levels of the resource become superfluous [Golann, 1963; Meer and Stein, 1955; Schubert, 1973].

Resources do not always compensate for each other because of these underlying functions. In some cases, increases in one resource to compensate for a low level on another may be detrimental rather than helpful. For example, if a person becomes too global in intellectual style, the contribution of the intellectual-style resource to creative performance will decrease. In this case, the change in intellectual style does not offset low levels of other resources. When compensation does take place among the resources, it is hypothesized to be a partial compensation, at best.

To summarize, creativity is seen as the result of a combination of the 6 resources and their interaction effects. The degree to which a resource contributes to creative performance is determined by the level of the resource and the functional relationship of the resource to creativity. These relationships may take the form of an inverted-U function or an increasing function that approaches an asymptote.

Testing the Investment Theory

Empirically, is the investment theory sound? We are currently pursuing a multivariate study of the investment theory [Lu-

bart and Sternberg, forthcoming], to be reported in full at a later date. The goals of this initial research are to test the importance, conceptualization, and confluence of resources. An assessment battery included measures of intellectual processes – Cattell's Culture Fair Test of 'g' [Cattell and Cattell, 1963], the Stroop Color-Word test [Golden, 1975], the letter series test [Thurstone, 1962], and our own test of intellectual processes; a measure of knowledge – a biographical questionnaire; measures of intellectual style – the Intellectual Styles Questionnaire [Sternberg, 1989] and the Myers-Briggs Type Indicator [Myers and McCaulley, 1985]; measures of personality – Gough's Adjective Checklist [Gough and Heilbrun, 1983] and Jackson's [1984] Personality Research Form; and measures of motivation – our own motivational measure and Torrance's [in press] Creative Motivation Scale. Environmental effects were not explicitly measured.

New Haven community residents (24 males, 24 females) completed the preceding tests and questionnaires after finishing a set of tasks requiring creative performance. The mean age of the sample was 33.40 years (SD = 13.79) with a range of 18–65 years. The mean education level was 15.10 years (SD = 2.24) and the mean IQ was 111.42 (SD = 23.45). The creative-performance tasks consisted of the production of two drawings, two creative stories, two advertisements, and two scientific problem solutions. A range of topics was provided for each domain. Some drawing topics were 'hope', 'rage', and 'earth from an insect's point of view'. 'Beyond the Edge' and 'The Octopus's Sneakers' were titles to be expanded into stories; 'bowties', 'brussels sprouts', and 'the IRS' were topics for advertisements; and 'How we could detect aliens among us' was presented as an open-ended scientific problem. Each piece of work was rated by a panel of 15 peer judges (8 males, 7 females; mean age = 41.07 years, SD = 13.02) for creativity, novelty, appropriateness to topic choice, integration of diverse elements, technical goodness, aesthetic value, and effort [Amabile, 1982b]. Subjects' profiles on the questionnaires and tests that measured the 6 resources served as independent variables used to predict creative performance.

Across task domains, the intellectual-processing resource was the most important for creativity. In particular, fluid ability tests and our own measures of selective encoding, comparison, and combination skills were strongly correlated with creativity ($r = 0.51$–0.61, $p < 0.001$). Knowledge, the second resource, showed a positive relationship to creativity ($r = 0.52$, $p < 0.001$), although no support for an inverted-U function was observed. The lack of support for an inverted-U function might have been due to the tasks themselves, which did not require a very high level of expertise, or to the subjects in our sample, who did not often possess very high levels of knowledge in the domains studied. For intellectual styles, a higher level of creativity was associated with lower levels on the executive ($r = -0.34$, $p < 0.05$) and conservative styles ($r = -0.40$, $p < 0.01$). However, we did not find strong support for the positive influence of legislative, liberal, or balanced global-local styles. In fact, the global style was negatively related to overall creativity ($r = -0.35$, $p < 0.05$). By considering the task environment resource, we can understand this finding. Our tasks required creative solutions to be produced on demand within the range of alternative topics we provided for each domain (drawing, writing, advertising, and science). These constraints

might have favored a local intellectual style. A global style would be useful when choosing a field of work, or a specific topic, when given unlimited possibilities.

Of the 5 personality dimensions, desire to grow ($r = 0.39$, $p < 0.01$), individuality, tolerance of ambiguity, and willingness for risk showed a range of positive correlations with creativity. Due, perhaps, to the short-term nature of our study, perseverance was essentially unrelated to creativity on our tasks ($r = -0.01$). Similar in magnitude to the personality resource, an intermediate motivational level proved to be optimal for creative performance ($r = 0.41$, $p < 0.01$), in accord with the Yerkes-Dodson law [Yerkes and Dodson, 1908]. Compared with the cognitive resources, the personality and motivation resources may explain a small percentage of the variance in any given piece of work, but still have cumulative explanatory power [Abelson, 1985]. Overall, the most powerful predictors in this study were intellectual processes, then knowledge and intellectual style, followed by personality and motivational variables (overall $R = 0.81$, $p < 0.001$).

Strong evidence did not emerge for the predicted interaction of resources. After entering the resources themselves into regression equations, the interaction terms did not add significantly to the overall level of prediction of creative performance. Our sample, however, did not show adequate representation at the extremes for some resources. Further research, perhaps with people specifically possessing high or low levels of each resource, is needed to test rigorously for the existence of the interactions.

An important aspect of the results was the variability in creative performance across domains. Across the tasks of drawing, writing, advertisement design, and scientific problem-solving, correlations of creativity scores ranged from 0.23 (n.s.) to 0.61 ($p < 0.001$), with a median correlation of 0.42 ($p < 0.01$). These correlations are moderate. A trend analysis indicated that several subjects tended to be creative in one domain, average in others, and below average in another. Providing further evidence of the multifaceted nature of creativity, these results suggest that a specific combination of the 6 resources can yield a high level of creative performance in one domain but a lower level in another domain, based on domain requirements. If there is a single ideal combination of resources that produces a high level of creativity across domains, then it is extremely rare. To summarize, there is evidence for both domain specificity and domain generality in creativity. Some domain-specific relationships between the resources and creativity exist. We have concentrated on overall creativity in this report because all of the fundamental results can be seen in the composite analyses.

Age was positively related to creativity in the advertising and science domains through 30 years, at which point the relationship turned negative. The negative effects of age may have been due to a characteristically lower level of ability to cope with novelty, a more conservative and executive intellectual style, or more conformist personality traits. However, it is also possible that generational differences existed between producers and raters in terms of their view of, or standards for, creative work. We are currently testing this notion. The preliminary results that have been obtained to date provide some support for the empirical validity of the theory. We are currently performing more detailed tests of the theory.

The Development of Creativity

Childhood Influences: The Impact of School

To a large extent, a society invests in its future through its educational system. According to Walberg's [1988, p. 342] human capital theory and our own investment metaphor, 'parents and educators can be viewed as developing an individual's [resources] of knowledge, skills, and talents'. The education of creativity, in particular, can be viewed as a benefit to both the individual and the society. Observation and research indicate, however, that schools often do not promote creativity. Consider the effect of schools with respect to each of the 6 resources in our theory.

Intellectual Processes

Schooling may contribute to intellectual development, but it is less likely to contribute to creative development. Creativity involves the definition and redefinition of problems. Schooling often encourages acceptance of existing societal definitions of problems. Teachers structure the class and the assignment; students are expected to accept that structure. Diverging too far from the constraints of an assignment is likely to result in a lower grade or the student's being required to do the assignment over. On tests, structured problems are usually given, and students who do not respond within that structure get problems wrong. In science, laboratory exercises often involve nothing more than the repetition of experiments that have been done before. In art, it is common for students to be told what to draw.

Because students are rarely given the opportunity to formulate and structure their own problems, or to restructure existing ways of seeing things, they often do not develop creativity-relevant skills of problem formulation and redefinition. The recommendation for schooling is clear: Do not always give children the problems to solve, on the view that problem-solving in itself is sufficient to develop higher-order thinking skills. At least some of the time, let students choose and structure their own problems, so that they become creative as well as critical thinkers.

Knowledge

Schools encourage the development of a knowledge base. However, in traditional schools, subject areas are often treated as discrete, unconnected domains [Thomas and Berk, 1981]. To a large extent, students may not develop associational links throughout their knowledge bases. For example, in our own experience, students often know statistical concepts but do not see connections between these concepts and research design, or to life in general. Facts should not be isolated, inert entities that have little relevance to daily life. Scholastic tests often measure the extent of knowledge, as opposed to how well it can be used. In terms of creativity, flexibility in the use of knowledge is at least as valuable a commodity as quantity of knowledge.

Intellectual Styles

Giving children problems and requiring them to work exclusively within existing frameworks not only stifles the exercise and development of creative intellectual processes, but stifles the exercise and development of a legislative style for expression of the children's intellect. The payoffs in school are generally for the executive style – for doing and wanting to do well what one is told to do [Sternberg and Martin, 1988]. An

emphasis on well-defined convergent problem-solving also favors development of local and conservative styles.

Personality

Schools generally socialize children to be conforming and to avoid significant scholastic risk-taking. At the secondary level, taking a difficult course presents the risk of a low grade, which may be detrimental for college admission. Moreover, colleges generally prefer a fairly standard and even rigid secondary-school curriculum, channeling children into courses that may not be those that the children would like most to take and from which they would profit the most.

Until, perhaps, the doctoral dissertation for those few who go on to graduate school, there are few assignments that help students develop their tolerance for ambiguity. Assignments are generally highly structured and fairly short-term, so that any ambiguities must be quickly resolved, to meet a deadline. If and when they enter advanced training, students have had almost no scholastic experiences that help them learn to tolerate ambiguity, if only because the curricula in our schools are so often set up to resolve any ambiguities that might arise.

All children encounter obstacles in school, so their willingness to overcome obstacles will almost certainly be challenged at varying points in the school experience. But the lesson, when the obstacles inhere in the system of schooling and its contents, is to play the school game, whatever it may be [Heath, 1983; McDermott, 1974]. The lesson certainly is not to try to change the way that schooling is done or that the curriculum is structured. Students learn to surmount obstacles in an uncreative rather than in a creative way.

Motivation

As noted earlier, a key ingredient of creativity is task-focused motivation. Schools seem to foster goal-focused motivation by making grades, class rank, or prizes more salient than the school work itself. Indeed, it is a rare teacher who has not encountered numerous students (some would say, a majority) who are just concerned with 'getting a good grade'. Amabile et al. [1986] have found that contracted-for rewards, in general, lead to decreases in creativity in both children and adults. When Pearlman [1984] experimentally increased the salience of grades among 11- to 12-year-olds, he found that effectance motivation to choose intellectually challenging problems decreased.

Environmental Context

Teachers can create classroom environments that foster creativity or stifle it. Chambers [1973] conducted a nationwide study of 671 college teachers who were nominated by previous students as positively or negatively influencing their creativity. The nominating group of students had recently received doctoral degrees in psychology or chemistry. Survey responses indicated that creativity-facilitating teachers tended to conduct classes in an informal manner that allowed student choice of topics; they welcomed unorthodox views, rewarded creativity, expressed enthusiasm, and interacted with students outside of class. The three most important traits of facilitating teachers were treating students as individuals, encouraging student independence, and functioning as a creative role model. Inhibiting teachers, in contrast, were described as having opposite characteristics, such as discouraging ideas, emphasizing rote learning, and being insecure or rigid.

A line of research on teachers' views of the ideal student provides evidence on the evaluative component of the school environment. Torrance [1964] used an Ideal Child Checklist composed of characteristics that empirically had been found to differentiate high and low creative people. A total of 264 teachers ranked the items in terms of desirability. The teachers' view correlated 0.51 with the rankings of 10 creativity experts who had studied the topic of creativity for 1 or more years. Some of the ideal pupil traits that teachers approved of more than did the experts included popularity, social skills, and acceptance of authority. Traits disapproved of by teachers, as compared with experts, included question-asking, being a good guesser, independent thinking, and risk-taking. A replication with another sample showed a lower rank-order correlation of 0.20 between teachers and creativity experts' views of the ideal child [Kaltsounis, 1977]. Another study with gifted teachers and a new panel of experts found extremely high agreement on ideal child characteristics, $r = 0.95$ [Murphy et al., 1984]. Taken together, these studies of the ideal child suggest that teachers vary widely in the extent to which creative characteristics are valued. Research on teacher's differential treatment of children identified as 'bloomers' suggests that views of the ideal child will have profound effects on teachers' classroom behavior and on the development of creativity [Rosenthal et al., 1974].

The Confluence of Resources

Creativity is hypothesized to be an interactive function of the 6 resources. The popular description of schools on a traditional-formal versus open-informal continuum suggests that development of resources may co-occur in some schools to inhibit strongly or to promote creative development. Studies of creativity in traditional or open schools have yielded mixed results, which may be due to methodological problems [Kogan, 1983]. A well-designed study by Thomas and Berk [1981] used a test-retest procedure, explicit rating criteria for school types, the Torrance Tests of Creativity, and a sample of 225 children in 9 schools. Although the effect was greater for female students, the most formal and traditional schools showed the least creativity enhancement over 1 year, with a decrement below baseline in some cases.

Creativity over the Life Span

In addition to the influence of schooling on creativity, family environment [Datta, 1967; Silver, 1983; Simonton, 1987], the presence of eminent creative role models [Simonton, 1975], and the Zeitgeist or spirit of the times [Simonton, 1975, 1987, 1988b] are some of the elements that can affect the development of our 6 resources and the emergence of creativity. The development of creativity does not stop in young adulthood, however. Just as an investor's portfolio of assets may evolve over time with desire for risk and with market conditions, an individual's profile on any of the resources in the investment theory may change. Subsequently, the level of creativity will fluctuate over the life span.

There is some evidence that creative performance declines in old age. Lehman [1953] studied the relationship between age and achievement of notable contributions. Over several fields of work, major creative contributions peaked in the 30- to 40-year range. Dennis [1966] addressed the potential of

sampling bias in Lehman's data by exclusively studying total productivity of eminent creators who lived 80 or more years. The most productive years in this group were in the 20s and 30s in art and in the 40s for scientists and scholars. A sample of 10 extremely eminent composers also demonstrated a peak productivity near age 40 [Simonton, 1977]. These findings support Lehman's results because the most productive periods are also the most creative periods [Simonton, 1988b].

In terms of the investment metaphor, decreases in productivity can be described as decreases in the diversification of one's investments. If one's range of endeavors decreases, then the chance of success also tends to become more restricted. Taken together, the studies of eminent creators suggest the existence of an inverted backward-J trend such that productivity and creative performance increase to age 40, approximately, and then decrease slowly through the rest of the life span [Simonton, 1977, 1988b]. Peak creative age does vary across fields. For example, mathematicians seem to peak much earlier than novelists. But the general shape of the function is consistent.

A cross-sectional study of 111 teachers, aged 20–83 years, provides some grounds for extending the age-related findings across the creativity continuum [Alpaugh et al., 1976; Jaquish and Ripple, 1981]. Guilford's paper-and-pencil measures of creative thinking revealed a decline in the quantity and quality of ideas produced over age. Of course, such tests measure creativity 'in the small' rather than 'in the large'. However, the ratio of creative ideas to total ideas produced remained relatively constant across age levels. This result and the fact that low productivity seems to drive declines in creative quality in eminent samples implicates those resources that can most affect productivity. The personality, motivation, and environmental resources may be most involved in the negative age trend.

The willingness to take risks, for example, declines with age, as does tolerance of ambiguity [Alpaugh and Birren, 1977; Botwinick, 1973]. In Alpaugh and Birren's [1977] study of teachers, the Barron-Welsh Art Scale was administered in addition to the WAIS intelligence measure and the Guilford tests. The Barron-Welsh test measures preference for visual complexity and ambiguity. Scores on it were negatively related to age. Given our current conceptualization of the personality resource, these age trends would lead to decrements in creative performance.

Motivation can also decline with age. Mumford and Gustafson [1988] explain the shift from major contributions in early years to minor contributions in later years using a motivational argument. With age, individuals are hypothesized to set more modest goals. The social structure of career advancement with its endpoint of retirement may also decrease motivation for innovative work in later years.

Environmentally, the most important changes may occur in the criteria for creativity. Over generations, raters' criteria can change. Therefore, an individual who creates a painting that is labelled creative by peers may find the painting to be considered outdated by younger raters. Another aspect of the social environment that negatively influences creative performance is the effect of competition, which increases in most fields over one's professional life span [Simonton, 1977]. Thus, creative contributions become more difficult as a field grows over time. We believe that these environmental effects,

when combined with personality and motivational changes, can account for much of the decrement found over the life span in creative performance.

Declines in intellectual processing abilities or knowledge can also occur. These changes will affect creativity, but intellectual declines tend to be quantitative rather than qualitative [Botwinick, 1977]. A final explanation for age decrements in creative performance is physical illness. Although physical health falls outside of the 6 psychological resources in our investment theory, the detrimental effects of physical illness on performance are clearly important [Simonton, 1977, 1984].

To summarize, the 6 resources of the investment theory can combine to yield creative performance at any stage of life. Schools have an important early influence on creativity. In later adulthood, creative performance may decrease when unfavorable changes in the different resources occur. On a population level, high levels of creativity are rare throughout the life span. Developmental trends may make high creativity even more infrequent in later adulthood.

Does the Investment Theory Cover Too Little or Too Much?

Some critics may argue that the investment theory covers too little or too much. Consider each of these possibilities. The first possibility is that some elements that affect creativity may not have been specified. Although the 6 resources are probably not exhaustive in terms of the psychological phenomena that give rise to creativity, we believe, with the support of our data collected to date, that the 6 resources proposed encompass the major sources of underlying variation that give rise to creative performance.

Other critics may argue that the investment theory covers too much. Are the 6 resources so powerful that they can explain performance in general on any task? No. The content of the 6 resources and their interaction effects have been conceptualized specifically with respect to creativity. Furthermore, the investment metaphor, which gives coherence to the 6 resources and highlights the importance of variables such as willingness to take risk, does not fit well with other related constructs, such as, for example, wisdom. However, the broad resource labels – intellectual processes, knowledge, intellectual style, personality, motivation, and environmental context – form a framework that can be used to understand many complex phenomena [Sternberg, 1990]. If we wanted to explain the level of wisdom displayed by a person in a situation, for example, we would (a) examine different variables under each resource, (b) predict that straightforward application of the investment theory of creativity would lead to significantly less explained variability for wisdom, and (c) predict that the relative importance of each resource would differ for creativity and wisdom.

Conclusions

Creativity does not stem from a single skill, trait, or ability. In order to understand and assess creativity, it is not sufficient to look merely at cognitive variables, or even cognitive variables in combination with affective or conative ones. One must look at

these variables in conjunction with the environment. Creativity is the product of 6 separate resources – intellectual processes, knowledge, intellectual style, personality, motivation, and environment. A confluence of these resources is necessary for creativity. The resources of creativity are not strictly additive, but interactive with each other. Truly creative performance is rare because people do not often possess ideal levels of each resource.

Tests that seek to measure some underlying 'ability' of creativity will be successful in only the most limited ways, because creativity is not a single ability or even multiple abilities. Rather, it is the confluence of abilities with other things. Some people have tended to look at creativity from the standpoint of the person, and others from the standpoint of the products. Using an investment metaphor, the present view builds on past ones in seeking to understand how the person and the product interrelate. We find creativity in our everyday lives as well as in the lives of great thinkers, but in order to find it, we need to know what to look for and to understand the resources that bring the phenomenon about. In order to manifest it, we need to be willing and able to 'buy low and sell high'.

Acknowledgement

Preparation of this article was supported by Contract N0001485K0589 from the Office of Naval Research, and Contract MDA90385K0305 from the Army Research Institute. This article was written while the second author was supported by a Jacob K. Javits Fellowship and a Yale University Graduate Fellowship. The authors thank members of Robert Sternberg's research seminar and several anonymous reviewers for helpful comments, criticisms, and suggestions.

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