Feldman, D.H. (1980). Beyond Universals in Cognitive Development (pp. 87-119). Norwood, NJ: Ablex.

4

Creativity – Trait versus Process

This chapter explores relationships among creativity, intelligence, and education within two broad traditions in psychology. The first of these traditions, which has often been referred to as a "trait" approach to human behavior, attempts to establish the existence and organization of enduring human qualities. The second approach concerns itself more with "processes" than with traits and aims to explain *how* people perform intellectual and creative acts. The main objective of the chapter is to demonstrate that the traditional trait concept of creativity has certain inherent conceptual limitations that may be fruitfully overcome by taking a process view; the process view to be offered was inspired by Piaget's description of developmental processes and grew out of my efforts at studying developmental transitions.

It may seem paradoxical for a theory like Piaget's which attempts to establish universal sequences in intellectual development to have inspired a conception of creativity, perhaps the most unique of all human activities. The relation between these two kinds of achievement becomes much clearer, however, if considered in terms of the framework presented in Chapter 1, which places the two—universal and unique—along a continuum of developmental advances. It is postulated that unique intellectual advances are similar to universal ones in that they share some of the same processes of acquisition and change. It was, in fact, in coming to grips with the full range of "novelties" in cognitive development—Piaget has called them "the great mystery of the stages"—that the commonality among creative works and other forms of

intellectual advances first began to appear comprehensible and even necessary and obvious.

To illustrate just how different these two regions of achievement—universal and unique—are typically perceived to be, let me describe a "natural experiment" that occurred in a developmental psychology class I taught at Yale. The students (about 100 of them) were viewing a film on intellectual development (Kagan & Gardner, 1972) in which a Piagetian conservation-of-liquid experiment was being shown. In the midst of showing a six-year-old child working on this task, the scene flashed to still photographs of Albert Einstein, Freud, Newton, and then Piaget himself! As the first photograph appeared the students broke into spontaneous laughter. The juxtaposition of Einstein and a six-year-old pouring water from one jar to another was apparently just too much, and the students quite reasonably seemed to find the two images incongruous and amusing. I am not sure what the film makers had intended to suggest by this cinematic device, but I think the reaction of my students was probably typical. Their laughter increased with each new photograph, until they guffawed with delight when *le patron* Piaget appeared.

What were my students laughing about? The film might have been trying to draw the viewer's attention to the fact that the processes of discovery are universal, that the child performing the conservation task might become an Einstein or a Freud, or that different problems are challenging at different points in time. Each of these notions, of course, has some merit, but what was it that struck the students as being so amusing? Were they amused by the juxtaposition of novice and genius? Since the film moved rapidly to another scene there was little opportunity for reflection, and it is impossible to tell in retrospect what was happening.

I believe that the effect of the cinematic link between "Everychild" and Einstein stimulated opposing sets of meanings in a pleasing and delightful manner; similarities and differences were played off one against the other (Koestler, 1964). Whether intentional or inadvertent, this little episode draws attention to the fact that the analogy between Piagetian stage advance and creativity is not an obvious one. When it is drawn, it must be drawn with the realization that it goes against common sense. Common sense says that Einstein was a preeminent thinker, sharing very little in mental organization and mental capacity with anyone, let alone with a six-year-old nonconserver.

The discrepancy between a great, even monumental intellectual achievement and an earthy, mundane one was sufficiently great for the prominent evolutionist George Gaylord Simpson (1974) to discard a Piagetian interpretation given to Darwin's achievements by Howard Gruber (Gruber & Barrett, 1974). In order to appreciate fully the differences between achievements that have substantial impact beyond one individual's insight and those achievements that do not, it is therefore necessary to examine the universal-to-unique continuum more closely. In this chapter, then, we shift our focus from novelties that seem to signal reorganization in cultural domains to novelties at the extreme of the continuum that reorganize whole domains themselves.

TRAIT AND PROCESS

Since one of the objectives of this chapter is to present a view of creative intellectual processes as distinguished from traits, some of the more salient features of the trait approach to creativity should be noted, as it is in terms of these features that processes and traits are compared.

A trait approach has guided most empirical research in creativity (Nicholls, 1972). A trait view, first of all, emphasizes increasingly precise study of differences among individuals. J.P. Guilford, the father of the trait approach to creativity, stated the position clearly in his 1950 presidential address to the American Psychological Association:

> I have often defined an individual's personality as his unique pattern of traits. A trait is any relatively enduring way in which persons differ from one another. The psychologist is particularly interested in those traits that manifest themselves in performance; in other words, behavior traits . . . . Creative personality is then a matter of those patterns of traits that are characteristic of creative persons. (Guilford, 1950, p. 444)

Creative traits, by definition then, had to be considered to differ from "intelligence" traits in order to give them some potential for predicting achievement above and beyond IQ. Intelligence, of course, had been operationally defined through the IQ measurement long before work in creativity began. If researchers were to establish creativity as a trait, therefore, they faced the practical necessity of demonstrating substantial independence of creativity from IQ. This, in effect, is what the last twenty-five years of creativity measurement research has attempted to do, with only limited success (Wallach, 1971).

There were also pragmatic reasons for justifying the construction of creativity tests. Intelligence tests had proved valuable to society in many ways, including the more efficient deployment of manpower resources during both world wars, but the predictive value of IQ measures had been found to be poor in situations requiring production and evaluation of *new* ideas. In his 1950 address before the American Psychological Association, Guilford proposed that a trait approach to creativity could overcome this deficiency and thus could become a vital tool for the

maintenance of America's scientific and technological superiority. From Guilford's perspective, it was more important to be able to *predict* creativity than to understand it. And, as it happened, many of the resources marshalled to support creativity research (a substantial portion of which went to Guilford himself) were poured into the development of tests to predict creative behavior in scientific laboratories and military settings (Wolfle, 1951). Practical as well as scientific considerations therefore influenced the desire to define and measure a trait or set of traits, different from intelligence, that would predict original and productive thought in technologically strategic settings.

Assumptions

A trait approach generally presumes that human beings come into the world with a set of potentials that will naturally express themselves except under the most dire conditions of deprivation. Everyone presumably comes equipped with some quantity of each of the essential human traits, and these quantities determine how well he will perform in many situations. Traits, from this point of view, are relatively immutable, stable and quantifiable, and if measured accurately, predict behavior in a wide variety of situations.[1]

A process emphasis, in contrast, focuses on the interaction between organism and environment—the ongoing, everchanging construction of behavior. Except in the obvious sense that each human being has certain inherent potentials, process psychology does not assume that the individual is a cluster of specific metric qualities which determine his future behavior more or less independent of environmental circumstances. Indeed, the very notion of traits seems to the process psychologist to be misleading, since behavior is always seen as a joint function of individual and situation; behavior itself is a sign of a process going on and not a function of a trait. In this respect, the process approach to human behavior concerns itself less with predicting who will achieve distinction than with understanding under what circumstances an individual (including exceptional individuals) expresses his or her potential. It is therefore not surprising to find that a trait treatment of creativity often gives little explicit consideration to factors affecting the likelihood that an individual's potential will be realized. This is the case because, in principle, the traits themselves provide the impetus to achieve their potential, making trivial issues such as the conditions under which one achieves full expression of potential.

[1]It should be noted that Guilford and others who have fostered traiit research have explicitly declined taking a stand on whether traits are "hereditary" or "environmental." I will show later how the logic of the trait-approach really leaves no choice in the matter.

In Guilford's classic paper, for example, only the most superficial treatment is given to intervention strategies or educational efforts to enhance creativity. With uncharacteristic brevity Guilford writes:

> . . . I will venture one or two opinions on the general problem of the development of creativity. For I believe that much can be done to encourage its development. This development might be in the nature of actual strengthening of the functions involved or it might mean the better utilization of what resources the individual possesses, or both. In any case, a knowledge of the functions is important. (Guilford, 1950, p. 448)

By "functions," of course, Guilford means traits. The role of environmental influence, then, is to either make better use of the "functions" or traits that a person displays, or to try to increase the functions themselves. A more active role for environment is allowed from a process perspective since there is assumed to be mutual regulation and construction of regularities in behavior between the individual and the conditions which prevail upon him.

By framing the problem of creativity primarily in trait terms, psychologists made both implicit and explicit decisions about what to look for and what to ignore when they began their creativity research. Unfortunately, some of these assumptions have been forgotten over the years. What began as a rather limited aim to produce some useful predictive measures has grown into a dominant "concept of creativity."

The general point to be made here is that the questions asked about a phenomenon, as Caplan and Nelson (1973) have argued, determine to a significant extent the range of answers that may be found. The trait approach to creativity was useful for the purposes for which it was developed, i.e., to guide the search for reliable measures of the traits of creative or potentially creative people. But in making this the goal of creativity research, certain other problems were ignored or equivocated. Still, trait approaches to creativity have made important contributions, and it is appropriate to summarize these contributions before going into the more process-based view in greater detail.

Creativity Trait Measures

A substantial body of data deriving from trait research now suggests that there is a realm of intellectual performance, testable by reliable means, that is independent of IQ and at least somewhat related to actual "real world" creative achievements (Wallach, 1971). The abilities in this realm are assessed by various measures, typically paper and pencil tests that deal with fluency in the production of ideas (cf. Crockenberg, 1972). Creativity measures thus contrast with IQ tests as well as with standard achievement tests, which aim to deal with abstract skills such as vocabu-

lary, analogizing, using formal logic, manipulating spatial relations, or organizing parts into wholes.

Like IQ tests, creativity measures provide tasks for the subject to perform, but usually there are no "right" answers. For example, in response to the question, "How many ways can you think of to use a brick?" a subject might respond, "to build a house," "to build a barn," "to use as a door stop," etc. The number of appropriate uses determines the estimate of "ideational fluency," the metric that contributes most significantly to creativity test scores. Other components typically include *unusualness* of responses (e.g., "A brick can be used to make the toilet use less water") and the number of different categories into which responses fall (e.g., Torrance, 1966).

Critics have of course questioned the validity of creativity test instruments (cf. Crockenberg, 1972; Feldman, 1970, 1974; Nicholls, 1972; Wallach, 1968), but despite debate over how well creativity measures do their job, there is now little doubt that at least within the upper ranges of the IQ distribution (probably above 120 IQ) the relationship between creativity test scores and IQ is minimal (Wallach, 1971). More controversial than their independence from IQ, however, is the extent to which creativity measures actually predict achievement in nonacademic domains. Here, too, there is some supporting evidence for this correlation (see Wallch, 1971 for a good review; also Kogan, 1974), but this evidence is less compelling than that which tries to establish creativity measures as independent from IQ.

CREATIVITY AND EDUCATIONAL POLICY

Although the fruits of creativity test construction have been modest, the motives stimulating creativity research have influenced and, in turn, been influenced by educational reforms. The existence of a growing and vocal body of researchers committed to the development of new tests and creativity measures has given encouragement and support to educational innovation, with Guilford (1950) once again leading the way:

> Many of us teachers assert that it is our main objective to teach students how to think, and this means also to think constructively. Certainly, if we succeeded in this objective, there should be much evidence of creativeness in the end product. I am convinced that we do teach some students to think, but I sometimes marvel that we do as well as we do. In the first place, we have only vague ideas as to the nature of thinking. We have little knowledge of what specific steps should be taken in order to teach students to think. Our methods are shotgun methods, just as our intelligence tests have been shotgun tests. It is time that we discarded shotguns in favor of rifles. (Guilford, 1950, p. 448)

To the extent that schools have moved toward emphasizing the arts, critical thinking, hypothesis testing, "relevant" questions, and individualized instruction, the creativity test movement must be given some of the credit. Likewise, the extension of creativity test construction from adults to children of school age (Getzels & Jackson, 1962; Torrance, 1962; Wallach & Kogan, 1965) was stimulated by a desire to find ways to provide quality education for children who did not "fit" into the normal academic regime.

Creativity Training

While a variety of changes in educational practice have been influenced by creativity research, only one line of work bears directly on the educational process itself, and this line has been notably unsuccessful. It is useful to consider this work in some detail because it illustrates some of the problems into which the trait notion of creativity runs when attempts are made to extend it to the *process* of creative accomplishment, an aim implicit in Guilford's remarks just quoted. The work in question consists of attempts to increase creativity or creative ability by raising creativity test scores. (This rationale is directly analogous to one which led to the misleading conclusion that intervention programs which raise IQ scores produce changes in real world intelligence; see Kohlberg, 1968.) A number of programs intended to increase creative abilities have been undertaken (see Wallach, 1970, 1971 for reviews); the studies differ in the skills they train and in the techniques and procedures used to improve them, but *they all aim to influence creative ability itself.*

If creative abilities are presumed to be primarily *associative*, for example, then a program intended to increase the number, variety and unusualness of associations is stressed (see, for example, Reese & Parnes, 1970). If the number and variety of *categories* is taken as an index of creative potential, then a program intended to increase categorization skills follows. Likewise, various forms of problem solving and hypothesis generation have also been taught (e.g., Feldhusen, Treffinger & Bahlke, 1970; Olton & Crutchfield, 1969).

Although a number of these intervention programs have enhanced performance on various creativity tests, the programs can be shown to have been misguided in the belief that raising test scores improves creative ability itself, misguided by the very logic of the trait definition of creativity. Since a trait approach to creativity assumes that the traits to be measured will express themselves under most existing environmental conditions, it follows by definition that these traits should not be easily influenced by training (cf. Mischel, 1968, 1970). If they are easily influenced, they probably are not traits; if they are not influenced, they are

traits because training does not affect them significantly. *Thus, the definition of traits precludes the possibility of change through intervention.*

Unless some revision of the trait view is permitted, these programs basically fail when they succeed and succeed when they fail. They fail in the former case because what they improve is performance, not the "underlying" ability. They succeed in the latter case because they support the notion that traits are not easily modified—but their "success," of course, comes at the price of no improvement in test scores.

The kind of revision of the trait approach to creativity that would be required for it to logically permit effective training studies has already been adopted in the trait approach to intelligence. Early education programs such as Head Start were rationalized in terms of the presumed effects they would have on IQ scores and, by implication, on "intelligence" itself. These programs were motivated by the belief that intelligence was not fixed at birth and could be potentially enriched or impoverished during the first four or five years of life by environmental conditions. The now common, misleading statement that intelligence is one-half determined during the first four years follows from this modification of the trait concept of intelligence (cf. Bloom, 1964; Hunt, 1964).

While there is now some basis for believing that IQ is at least somewhat modifiable during the first years (Scarr & Weinberg, 1976) it is only by unsupported analogy that the same argument can be made for creativity test performance. Indeed, to my knowledge no programs to improve creativity test performance have been attempted during the preschool years at all, so the analogy was at best a stretched and strained one, at worst simply irrelevant.[2]

Whether implausible or incredible, such a revision of the trait conception of creativity has also been implicit in the manner in which intervention programs have been rationalized. It is more likely that the fallacies in the trait researcher's assumptions would have become obvious to the proponents of intervention programs if the underlying assumptions of the modifiability of traits had been made more explicit. For example, the assumption that increasing acreativity test scores increases creativity itself rests on the mistaken belief that correlation implies causation, one of the most common errors made in such research. Wallach (1971) points out in this connection that although one variable may *predict* another, altering the former will not necessarily produce concomitant changes in the latter:

> That ideational productivity (i.e., creativity test performance) shows a moderate linkage with creative attainments does not offer a warrant for assuming that whatever enhances the former will, by virtue of that fact, also enhance the latter. (p. 21)

To actually enhance creativity, in other words, interventions must deal with creativity, not its correlates. Raising creativity test scores is no warrant to claim that "creativity" has been affected. Therefore, although training studies have generated considerable interest, they deservedly have had little impact.

[2]The work of Jerome Singer (cf. Antrobus, 1970) is perhaps the closest to a training program at the preschool level. But Singer's work uses "creativity" tests as an indication that enhancing play and fantasy have significance beyond their own intrinsic values, i.e., that they affect creativity in some way.

Beyond IQ

A more positive, though indirect, influence of creativity research has been to help show educators that there is more to a child's intellect than IQ. Considering the pervasive influence of IQ tests on educational practice as well as on common knowledge and conventional wisdom about intelligence, convincing the public that IQ represents only part of the repertoire of human abilities has been no small achievement. Creativity research did not, of course, accomplish this change by itself (and it should also be noted that IQ remains in the minds of many, professional and nonprofessional alike, as the most powerful indicator of intellectual potential; cf. Brim et al., 1969), but interest in creativity helped to lessen the monopoly of IQ as an indicator of general ability.

A related shift in educational policy that is also partially attributable to the influence of creativity research is the growing tendency to rely less on test scores of any sort to determine admission to college and other special programs of study. Wallach and Wing (1969) have been perhaps the most influential among creativity researchers in fostering this trend. In their book *The Talented Student: A Validation of the Creativity-Intelligence Distinction*, Wallach and Wing showed that College Board (SAT) scores did not predict nonacademic accomplishments among newly admitted Duke University students. They urged admissions officers to consider evidence other than grades and test scores in admitting new students, and indeed, many universities have followed this lead. The argument in brief is that standardized IQ test scores predict only two aspects of achievement: the likelihood that a student will be able to do the work required by the college or special program for which he is being considered, and the grades he will receive. Since grades in college or professional school are said to have relatively little value for predicting success in a given field, it is therefore not unreasonable to select individuals at least partly on the basis of other, nonscholastic achievements. The result of such a policy is a more diverse student body, if not a uniformly excellent one, and a greater probability that the students will make worthwhile contributions in nonacademic domains. Although the Wallach and Wing

research had many methodological flaws (cf. Feldman, 1970), these seem not to have stood in the way of its influencing policy.

Creativity tests have also been added to the armamentarium of the school psychologist with the rationale that some gifted students may be missed when screening only with traditional IQ tests (Bruininks & Feldman, 1970). What the schools then do with their newly discovered "extra talent," however, has not been as carefully planned. This is not surprising when considered from the perspective of the trait approach to creativity which generally assumes that a trait will express itself except under the most severe environmental deprivations. From this point of view, the responsibility of the educational system is not to influence traits but rather to *identify* them; a satisfactory education system is not necessarily one which adjusts to accommodate varying sets (or levels) of abilities and skills, but one which identifies existing talent in the population and expends its resources on encouraging the more gifted students to go forward, relegating the less talented to the lower ranks. Educational programs for "gifted" and "creative" students have therefore been typically limited to poorly defined "enrichment," which most commonly consist of offering greater quantities or variations of the standard school curriculum. The identification process by itself yields very little information about the nature of the abilities which might, in turn, suggest how curricula might be designed to effectively challenge the special abilities revealed by creativity or by other tests.[3]

In summary, most "creative abilities" research has emphasized: (a) measurement of capabilities that are believed to predict creativity, and (b) the selection of individuals with substantial "amounts" of these traits for special recognition. Very little information directing the organization of programs has followed from this work. While different settings may provide somewhat different programs for enhancing "creative potential," almost all seem to draw heavily on the regular school curriculum. To the extent that training programs to increase creativity have been undertaken, they have emphasized attempts to change underlying "abilities." In the case of open or informal schools, creativity measures seem to be used to buttress the policy decision to maintain a more informal program. While research guided by individual trait assumptions has succeeded in demonstrating the existence and importance of abilities other than IQ, it has been limited by its own assumptions to only recognizing a new set of traits. These assumptions make it difficult, if not

[3]The only major exception to this rather bleak picture is research examining the effects on creativity of open versus traditional classrooms (cf. Hadden & Lytton, 1968). As of this writing, relatively few studies have been done, and, as they depend on divergent thinking measures to assess creativity, they fall prey to many of the same fallacies as other intervention research.

impossible, to address the question of what to do to enhance their expression. In other words, the emphasis in all creativity trait research is on prediction and selection in preference to development and enhancement.

PERSONALITY TRAIT STUDIES

Another line of research based on a trait perspective has focused on the qualities of the creative personality as distinguished from creative conceptual abilities. The distinction between personality and ability is, of course, never a clear one, but the lines of investigation followed by those who profess interest in one versus the other have tended to be quite distinct. While Guilford had set the problem for the field in 1950 as the investigation of the overall creative personality, few have engaged in research designed to examine both the personal characteristics and the cognitive abilities that might be possessed by creative individuals. Guilford's own work has remained primarily in the area of conceptual abilities, while the work of other investigators has added to our knowledge of personal qualities or traits characteristic of creative individuals.

I will not attempt here to review the voluminous literature on the creative personality; in this section I will only deal with some of those studies which attempted to provide empirical measurement of various qualities of personality that might be related to creative productivity. I choose to focus the discussion on this empirical work primarily to draw attention to another problem that has plagued studies of creativity. I am referring specifically to what I believe is a conceptually limiting preoccupation with the importance of individual traits in determining whether or not creative work is likely to be done (Feldman, 1975). The trait approach has tended to deemphasize the subtle but critical role that various environmental conditions may play in the creative process, not the least of these, as we shall see, is the state of a body of knowledge itself.

To be more explicit, I would suggest that a very strong belief in individual responsibility has given an overriding vote in creativity research to the search for traits (cf. Sarason, 1978). The emphasis is reflected in the tendency to look almost exclusively for the personal qualities that distinguish individuals who have done creative work. This is not to say that the unique qualities of creative individuals are unimportant; it is simply to suggest that the preference for an individualistic explanation for creativity is one which, fitting well with prevailing cultural attitudes, may tend to blind us to other important factors. Consider the evidence.

Research effectively began with Frank Barron's finding in the early 1950s that art students described as "creative" by their professors tended to prefer objects, drawings, and block constructions of greater complexity of pattern than did students designated as relatively noncreative. This observation led Barron to do a series of studies exploring the possibility that creative individuals prefer the more complex and ambiguous than do noncreative persons. In studies spanning more than a decade, Barron (1955, 1968) demonstrated the general predictive validity of his preference measure with individuals from various professions and groups including artists, architects, physicists, and others. Generally speaking, it was true that individuals designated by superiors or peers as creative tended to prefer more complex arrays of stimuli than noncreative individuals. This led Barron to the conclusion that there exists a dimension of personality that runs along a continuum from complexity to simplicity, with more creative people falling at the "complex" end.

It should be evident that the intent of the research carried out by Barron and his coworkers was, as it was for Guilford, to identify and measure a quality of human behavior that would persist over time and predict differentially among individuals. Similar to the creative abilities work in this respect, the hope was to find stable, enduring, measurable qualities of the individual that would distinguish the more from the less creative. And within the limitations of the methodology used (from the previous discussion it should be evident that they are substantial), some reasonably reliable differences were found.

A related series of studies was carried out by Donald MacKinnon, a colleague of Barron at Berkeley. MacKinnon studied personality differences among groups of architects, physicists, mathematicians, officers in the military, etc. nominated as creative by their peers. MacKinnon used a battery of psychological instruments and did intensive interviews and assessments with subjects over a three-day period (in most instances). It was from this extensive set of observations that MacKinnon hoped to find how the creative individual differed from his peers.

As was the case with the creative abilities research, some modest additions to what we know about creativity have been made by this work. While the results have never been dramatic, over the years the MacKinnon group and others around the country have slowly built up reliable information about individuals who are said to be creative by someone presumably in a position to know. Without going into this literature in detail, a few representative findings give the flavor of this work, as summarized in this passage from a chapter I wrote on problem solving and creativity:

> As measured by psychological tests, . . . three groups of architects did differ in personality. The forty creative architects were more flexible and open minded than the other groups. They also had a wider range of interests, had a greater preference for complexity, and were less interested in small details and in practical and concrete problems. They were described as more ambitious, dominant, and achievement-oriented, markedly more mature, emotionally and aesthetically sensitive, independent, individualistic, and enthusiastic. They seemed to accept themselves, to be more introspective, and to exhibit traits typically referred to as feminine. In social relations, they tended to be unconventional, rebellious, self-centered, and exhibitionistic. In fact the creative architects seemed to be relatively free from conventional restraints and inhibitions, unconcerned with the impression they made on others. And above a certain minimum (about 120) IQ did not bear any relationship to creativity. (Feldman, 1973b, p. 383)

I would like to mention once again why I think this line of research is important in the present context. This kind of personality research illustrates another aspect of the belief system underlying the trait approach to creativity. This aspect is perhaps best thought of as a preoccupation with qualities of the individual as the primary cause of creative productivity. To go a step further, the underlying assumption seems to be that those qualities that are the root causes of creativity are very general and do not depend on special talents. These qualities of the personality determine whether or not an individual is likely to make a substantial creative contribution; talents are taken more or less for granted as necessary but not sufficient.

For both the creative abilities and the creative personality trait research approaches the cause of creativity is located deep within the individual, in a relatively small set of very broad traits. The direction of cause is from inside out. If one has the qualities of a creative thinker and the personality of a creative person, then one will be creative. The specific domain of expression is a function of some more specific and less critical traits or talents that determine the medium through which the more general qualities of creativity will be expressed. I have tried to illustrate the sense of how this is supposed to work in Figure 4.1

THE PROCESS VIEW

A trait position concentrates on constructing accurate measures of traits and assumes that their expression will occur naturally; in contrast, the process position views the identification of traits as inadequate in the absence of specific programs that promote their expression and development. As Michael Wallach (1971) has written:

> If we want to learn about the enhancement of creativity, we had better consider training arrangements that make a person more competent at creative attainments themselves—such as writing novels well, excellence in acting, skill as a musician, or quality of art work produced. (p. 23)

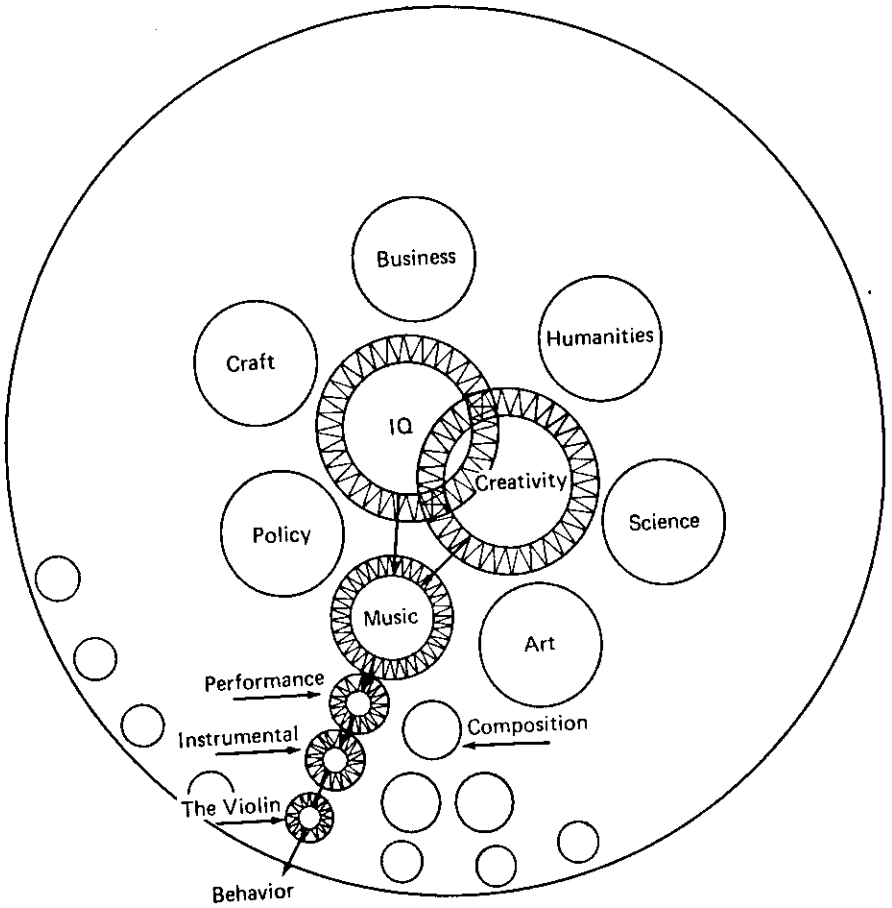

Figure 4.1 Cause and effect from the trait point of view. Illustration is of someone who becomes a violinist.

A second assumption of a process view, also implied in the above quote, is that it is a matter of crucial importance that the qualities to be fostered be enhanced through giving novices in a field the opportunity to develop their skills under the guidance of expert practitioners.

Obviously, discovery of talent is a crucial task, and a prerequisite to development. The problem has been, however, that the "traits" measured have been conceptualized as lying so deeply within the individual's personality, as being so much broader and more pervasive than any specific domain of performance, that specific programs for development of creativity would have to be very remote from the seat of the creative potential. Thus, the way in which traits are conceived tends to militate against both the enhancement of more field-specific abilities and the

careful consideration of relationships between domains of performance and individual predispositions, the fine tuning of individual to environment.

To move the notion of creativity more into the domain within which it is practiced, we must shift our vantage point from the qualities of the person producing creative works to the creative work itself—the product. Following this, we will return to a consideration of creative processes.

Identifying Creativity by the Product Rather Than the Person

It is true of course that creative people are not creative at all times, that some products of even distinguished individuals are not at all remarkable. Indeed, applying the most stringent criteria, it is rare for an individual to make truly lasting contributions more than a few times during a lifetime.

A very different way of thinking about creativity is to focus on creative works themselves rather than on the individuals who produced them. By attempting to identify and categorize creative products, the task for research is to establish what makes a creative product differ from a noncreative one. Taking the product as a point of departure leads to the possibility of giving differential weight to the quality of creative works, providing some way of quantifying the "goodness" of a work that has been produced. This has not been a very popular pastime of creativity researchers, but substantial progress toward establishing criteria for the evaluation of creative products has been achieved by Philip Jackson and Samuel Messick (1965). I will describe this work in some detail because it illustrates two points that follow from the previous discussion, but that are not obvious. First, the Jackson–Messick work shows that new light can be shed on creativity when the preoccupation with traits is transcended—in this case, when the focal point is moved from person to product. Second, the evaluation of creative products leads to the realization that the specific domain in which creative work is produced must be mastered before creative processes can be understood. Consider the criteria proposed by Jackson and Messick for determining the quality of a creative product.

The four criteria by which creative products are judged, according to Jackson and Messick, are *unusualness, appropriateness, transformational power* and *condensation of meaning*. Jackson and Messick call these criteria *response properties* because they are presumed to produce aesthetic responses of various kinds in a viewer or appreciator of a creative work (see Table 4.1).

Table 4.1*

Response Properties	*Judgmental Standards*	*Aesthetic Responses*
unusualness	norms	surprise
appropriateness	context	satisfaction
transformation	constraints	stimulation
condensation	summary power	savoring

*P. Jackson & S. Messick, The Person, the Product, and the Response: Conceptual Problems in the Assessment of Creativity. In M. Bloomberg (Ed.) *Creativity*. New Haven: College and University Press, 1973, Table 2. Originally appeared in: *Journal of Personality*, 1965, *33*, 309-329.

The response property of unusualness may be most readily grasped in a quantitative sense; to be judged creative a product must be highly original, i.e., it must occur only rarely. This criterion is utilized to some degree in current creativity tests (e.g. Torrance, 1966), as is the appropriateness property next to be described. The response in the viewer that unusualness is supposed to produce is that of surprise.

Appropriateness refers to the fit of a solution to the problem which stimulated it; an appropriate solution may stimulate a range of reactions in a viewer from "about right" to "an astonishingly perfect fit!" The notion of a "shock of recognition" often is invoked to give a sense of what the reaction is like when an appropriate solution has been grasped, almost as if one had seen the product somewhere before but in fact never had. As Bruner (1962) has remarked, what makes something obvious in this way is that at last one understands it.

The two remaining criteria, transformational power and condensation of meaning, are more difficult to describe. By transformational power Jackson and Messick refer to the extent to which a solution *breaks free* from the constraints of the original problem, departing from it in a manner which stimulates further thought and reflection. In its most powerful form, a transformation leaves a problem forever changed and a new set of problems is stimulated by the appearance of the product. The Copernican revolution and the theory of evolution are examples of powerful transformational solutions to problems which posed severe constraints.

Finally, the property of condensation refers to the interplay between complexity and simplicity found in the most extraordinary creative works. Einstein's formula $E = mc^2$ and the deceptively simple paintings of Albers are examples of extreme condensations of meaning. While the aesthetic response to transformational power is said to be stimulation and wonder, the effect of condensation of meaning is to

produce *savoring*, because the work has summary power that allows extended contemplation. The meaning held, for example, in the simple equation stating the relationship between energy and mass is so great as to be worthy of a lifetime's contemplation.

Unfortunately, little progress has been made in operationalizing these response properties in creativity research. Only one exploratory study has been completed to date, this by the author and his associates (Feldman, Marrinan & Hartfeldt, 1972); it merits a brief summary at this point.

In the Feldman et al. study, Torrance "creativity test" protocols were reanalyzed on the basis of three of the four response properties suggested by Jackson and Messick. The study used only the first three of the criteria since, in practice, the task in Torrance's test does not lead to condensation of meaning, at least not in the sample of high school students tested. Two judges were trained to estimate their aesthetic responses to the test answers, using their reactions to unusualness, appropriateness and transformational power as the scoring criteria. The hypothesis of the study was that the individuals judged most "creative" on the basis of the Jackson and Messick criteria would not be the highest scorers based on Torrance's (1966) standard creativity test procedure.

When asked to choose the six most powerful transformations among the Torrance protocols (a typical item is "how many uses can you think of for a tin can?"), the two judges agreed perfectly on their choices. The individuals who produced these six most powerful reponses ranked 2, 8, 11, 57 and 79 out of 87 subjects in terms of their creativity test scores as calculated by Torrance's procedures. (Two of the six most powerful answers were produced by the subject ranked 57th.) Thus, while there was some tendency for subjects who scored well on the Torrance test to produce powerful transformational responses, three of the six most powerful responses were produced by middle- and low-ranking subjects (see Table 4.2). Thus, some of the most "creative" answers were produced by low scorers on the Torrance test.

While the Feldman et al. study was a small pilot effort, it did suggest that empirical testing of the aesthetic response properties proposed by Jackson and Messick is at least feasible. *But the most important lesson learned from the study was that it was not possible to judge the quality of the protocols without first becoming "experts" in creativity test protocol scoring.* This conclusion seems obvious in retrospect, but it was not apparent in prospect. To put it more broadly, the criteria for evaluation of creative works are inextricably entwined with the field of effort within which the work is produced. Hypothetically, Jackson and Messick's criteria can be applied to any domain. But practically, each domain utilizes the criteria uniquely, and anyone proposing to apply the criteria must have reached a degree of mastery of the domain in question.

Table 4.2
Torrance Test Scores and Rank of Subjects Judged
to Have Produced the Six Most Powerful Transformations

Subject	Sex	*Torrance Total Score*	*Torrance Flexibility Score*	*Rank (out of 87)*	*Activity Number**	*Transformation*
A	F	296	74	2	7	"Prejudices concerning faces would disappear, but new ones would develop concerning feet."
B	M	229	59	8	6	"Why not make a tin can that destroys itself after being used so as not to litter highways."
C	M	194	36	11	5	"Capture good oxygen from polluted air."
D**	M	108	27	57	7, 7	"Babies would never learn how to walk because crawling would be better." "The midgets would have the best deal."
E	F	74	23	74	7	"Murders could not be witnessed and therefore not tried."

*ACTIVITY
#5 *Unusual uses* of tin cans
#6 *Unusual questions* about tin cans
#7 *Just suppose* a great fog were to fall over the earth and all we could see of people would be their feet. What would happen? How would this change life on earth?

**This subject had two of the six transformations judged to be most powerful.

This wisdom gained from hindsight is helpful in furthering our discussion of creative processes; the same generalizations seem to be equally true of creative *processes* as of creative products. The creative processes that I will discuss are also intended to be universally applicable, but they make no practical sense isolated from the field in which work is produced. This should be kept in mind as we proceed. Since I have few specific examples to cite, the dangers are substantial of seeing the processes of creativity as existing independent from a domain; they do not. Indeed, one of the aims of the process approach to creativity taken here is to explicitly question the premise of trait theory that creativity is a deep, pervasive, and stable entity existing independent from other more specific aspects of the individual.

CREATIVITY AND DEVELOPMENT: AN ANALOGY

The crux of my view of creative process is an analogy, or at least a partial analogy. Simply stated, the analogy rests on the belief that Piagetian stage-to-stage advances and creative accomplishments share certain common qualities. Recall that the primary aim of the trait approach was to look for differences, to make distinctions. Without denigrating the usefulness of this kind of activity, it does tend to draw attention away from *continuities,* continuities that may be as revealing as differences.[4] As the reader will see, the analogy to be drawn directs attention to possible new relationships and also makes distinctions heretofore blocked from view. There are two main features of the analogy. One is that the *experience* of achieving a qualitative advance is similar in both general intellectual development and in creative works. The second is that the *disequilibration* process suggested by Piaget occurs in certain fundamentally similar ways in processes reflective of both kinds of advances.

The Experience of Creativity

The crucial assumption of Piaget's stage theory of intellectual development is that new systems of operations, or rules for thinking, are constructed by the child and that these rules reorganize and expand existing modes of thought (Van den Daele, 1974). Piaget (1971) makes no pretense at being able to explain how these constructions occur and, as mentioned earlier, calls this problem "the great mystery of the stages."

Although Piaget does not consider creativity per se he does label

[4]One of the most common distinctions made between analytic thinking as required on IQ tests and creative thought is the difference between making distinctions versus making analogies (Bruner, 1962; Guilford, 1950), so it is not surprising that my thinking would take this turn.

newly completed thought operations as "novelties" or "creations" (Piaget, 1971). It is clear from the contexts in which the terms are used, however, that Piaget means by creations the universally acquired organizations of the cognitive apparatus that all children are believed to achieve; these novelties are thus creative only in the sense that the child has achieved a mental reorganization for the first time, going beyond his own limitations.

Piaget leaves little doubt that the initial achievement of a new set of rules of thought—no matter how common a set—can be a profound experience. Two instances of a sudden transition from one stage of reasoning to another illustrate Piaget's observation that there may occur a sudden insight that accompanies the shift in perspective, followed by a sense of having just discovered something incredibly *necessary* and *obvious*. Piaget (1971) describes the occasions in this way:

> . . . The striking thing here is that the child reaches this feeling of necessity as soon as he has understood the phenomenon in question. One can sometimes witness the precise moment when he discovers this necessity. At the beginning of this reasoning he is not at all sure of what he is stating. Then suddenly he says "But it's obvious." In another experiment where Bärbel Inhelder was questioning a child on a problem which is not as in the above situation that of seriation but of recurrent reasoning, but which also involves the feeling of necessity, the child was at first very uncertain. Then suddenly he said, "Once one knows, one knows forever and ever." In other words, at one point the child automatically acquires this feeling of necessity. (p. 5)

This coincidence—seeing a child solve a problem in a profoundly new way at just the time he or she happened to be in the experimental situation—gave Piaget the opportunity to observe a reorganization in the making. Despite the near universality of these particular achievements, every child who first conserves number, seriates for size, classifies according to a higher order category, etc. finds that he has acquired a deeply significant shift in capability. This jump forward (not necessarily temporally rapid) occurs following a period of sustained effort, resolves a whole set of related problems, and opens up new realms of experience (Kohnstamm, 1970).

Creative insights have been described in similar ways, although the terminology used is somewhat different (e.g., Ghiselin, 1952; Wallas, 1926). Jerome Bruner (1962) for example defines creativity as the occurrence of "effective surprise" in an individual who has produced a new work and/or who comprehends and appreciates that work for the first time. Effective surprise is to experience "the unexpected that strikes one with wonder and astonishment." Such experiences, Bruner continues, "have the quality of obviousness about them when they occur, producing a shock of recognition following which there is no longer astonishment" (p. 18). According to Bruner, effective surprise characterizes insights and achievements in all domains and at all levels of human endeavor; it is, as he puts it, the "hallmark of creativity."

The analogy between universal intellectual achievements and creative ones suggested by the preceding paragraphs has already appeared in the literature of educational thought in at least one place. A paper called "The Having of Wonderful Ideas" by Eleanor Duckworth (1972) presents an argument for the relationship of Piaget-like shifts in logical development to the entire spectrum of intellectual achievements, including creative ones. Duckworth draws the analogy most broadly:

> The wonderful ideas I am referring to need not necessarily look wonderful to the outside world. I think there is no difference in kind between wonderful ideas which many other people have already had, and wonderful ideas which nobody has happened upon before. That is, the nature of creative intellectual acts remains the same, whether in an infant who for the first time makes the connection between seeing things and reaching for them . . . or an astronomer who develops a new theory of the creation of the universe. In each case, it is a matter of making new connections between things already mastered. (p. 231)

Duckworth's "wonderful ideas" presumably come about through reorderings of previously unrelated elements. Of this process Henri Poincaré wrote that fruitful combinings "reveal to us unsuspected kinship between . . . facts, long known, but wrongly believed to be strangers to one another" (in Bruner, 1962, p. 19). It is as if one had "known" how the facts should cohere but simply had not perceived the obvious. The initial integration of parts into a whole may bring astonishment and wonder, accompanied by the sense that the whole has achieved its necessary form. Once the solution is achieved, the result may seem so obvious as to be laughable—after the fact.

Bruner also describes an aspect of the experience of creation that he calls "the freedom to be dominated by the object." Once a task is begun or a problem is perceived, a point comes when it begins to demand its own completion. The precise form of the end product is not clear, but its seemingly autonomous need to reach completeness is very powerful as a motivating force.

A final and related attribute common to Piagetian advance and creative accomplishment is the *irreversibility* of the change in perspective that the new achievement brings. By irreversible I do not mean that earlier forms of knowing are cast aside altogether, but only that the new perspective is always available (if not always chosen) for dealing with a class of problems. Once achieved, there is little likelihood that the individual will return to a prior state of organization of thought. As

Inhelder's young subject exclaimed, "Once one knows, one knows forever and ever."

This description of aspects of creative insight mirrors that of the initial completion of an "equilibrated structure," such as in Piaget's conservation and seriation examples cited earlier. A newly equilibrated Piagetian structure reorganizes previously unrelated elements according to a new set of rules. The reorganized whole functions in ways quite different from that which it replaces; each successive equilibrated structure is more stable, inclusive, and encompasses more possibilities than the previous one (Flavell, 1963, 1971). Bruner's phrase "the reordering of experience" is a most apt description of Piagetian stage advance, although it was written to describe creativity.

In summarizing, there are four attributes that creative accomplishments of all varieties, including Piagetian universal achievements, seem to share in common. They are:

1. The initial consolidation of a newly reorganized structure or way of dealing with problematic situations is often accompanied by astonishment or surprise.
2. This solution, once achieved, often seems obvious, and one finds it hard to believe that it was possible to ever have thought differently.
3. As one moves toward a solution there is often a strong—but difficult to describe—sense that the solution is "pulling" one toward it. This helps account for the fact that one often "recognizes" the solution when one achieves it, almost as if one had known it all along but had not quite been able to express it. Picasso has called this process "successive crystallizations of the dream," where the "dream" or solution itself never changes fundamentally but its manifestations on canvas become closer and closer approximations (Ghiselin, 1952, p. 27).
4. There is, finally, the irreversibility of a solution once it is achieved. While other modes of dealing with a problem do not necessarily cease to exist, the new solution expands for all time the available means to organize experience. The solution will be taken as superior and applied to whole classes of relevant (and often irrelevant) problems.

Obviously, the four attributes described in this section as common to the achievement of creative products in all forms, including Piagetian stagelike advance, are not independent. Taken together, however, they do convey the sense of analogy that I have tried to draw revealing continuities among the experiences of qualitative advance—whether they happen to be universal or unique.

CREATIVE PROCESSES AND THE EQUILIBRATION MODEL

We have discussed the criteria by which a creative work may be judged, and we have discussed the experiences that accompany a creative advance. Considering these matters sheds some light on the nature of the creative process. It is important to keep in mind, however, that the analogy drawn between Piaget's explanation of stage-to-stage advance and creative insights is based primarily on those aspects of Piagetian theory which deal with *process*; these aspects are usually referred to as the "equilibration model." The equilibration model is Piaget's attempt to describe in process terms the transition between stages of cognitive development. It should be mentioned that the equilibration model, while it is central to the present discussion, has not been so central to the work of Piaget over the past thirty years or so; that is, he has spent relatively little time elaborating upon it until quite recently (e.g., Piaget, 1975, 1977).

It is not my intention to go into great detail in describing the equilibration process; this has already been done in Chapter 3. But given the fact that the equilibration model is so central to the formulation presented here, I will briefly outline the features that pertain most directly to the problem at hand.

Each individual child (or adult) deals with the world in terms of a set of rules which are available to him. These rules are organized into constellations which make up the child's set of "schemes," or later, "operations," all of which might be taken as the frame of reference that guides the child in the processing of information. For Piaget, there are four (in some accounts only three) such general frames of reference that succeed one another from the birth of the child through adolescence. It is the equilibration process that is postulated to account for the fact that new constellations of rules are constructed, and that older ones are allowed to lapse into disuse. The manner in which these world views are constructed is pretty much as follows.

At any given point in time a child is capable of perceiving a certain range of problems that might occur within his purview. Some things that occur are simply not perceived; other things are perceived differently by individuals at different developmental levels. In the conservation of mass, for example, a very young child will simply not see a situation as problematic when a ball of clay is rolled into a long thin rod, back into a ball, and back into a long thin rod said to have changed its mass. The child will quite contentedly report that the amount of the clay changes with its form.

It may not even disturb the child to have a peer sit next to him and give blatantly different responses to the same question. In one of our own experiments with map drawing (Snyder & Feldman, 1977), two fifth graders sitting beside one another were drawing buildings from different perspectives. One student, who was drawing his buildings from a more or less 45° angle, complete with windows and chimneys, observed his neighbor drawing more abstract tops of buildings from a 90°

perspective. Neither child showed any sign of distress that the other had chosen a different way of dealing with the task; the discrepancy was not problematic to them, even though the 90° perspective is a more evolved, later developing system.

The critical point is that to be perceived a problem must fall between what the individual knows and what he feels capable of dealing with. If the discrepancy is too large, the child (or scientist) simply does not perceive it as problematic. If the discrepancy is too small, the child will "assimilate" the information to his already existing modes of dealing with the world. In other words, our cognitive apparatus seems to have a basically conservative initial tendency. If possible, the situation will be recognized as analogous to and applicable to another situation for which an already existing solution is available. It is only when the situation is perceived as unassimilable, yet soluble, that the conditions for change are present.

If the child is sufficiently upset by a perceived discrepancy and is not totally overwhelmed by it, there is an increased probability that the child will attempt to "accommodate" his way of looking at the world to the demands of the new situation. Thus, there seems to be an optimal discrepancy between where a child is developmentally and where the most promising problems lie in terms of stimulating genuine change (Kagan, 1971; Langer, 1969).

Alternatively, a situation perceived to be problematic may be too much of a threat to the existing hard-won view possessed by the child or adult. If the change is seen as too threatening, the child will be confused, disorganized, and anxious, and the likelihood of constructive change is not great. Once the disorganization and confusion has been reduced to a tolerable and then stimulating level, a more optimal state of "disequilibrium" can be achieved, and progressive change may take place. Following our analogy, a premise of the process view of creativity is that the same conditions that describe the equilibration process for general cognitive developmental advance pertain to unique advances as well. The distance between the two ends of the hypothetical continuum of advances is very great in terms of rarity, dependence on special environmental conditions ("cyrstallizing conditions"), and impact on other individuals, but not great in terms of the processes of transition that bring the advances about.

There are differences, of course, in the nature of the problem solved in each case, especially in the broader implications of a product or solution. Generally, it seems reasonable to assume that the more universal, broader, more fundamental shifts in point of view described by Piaget would pertain to and influence virtually everything experienced by the individual. Depending on the nature of the field in which unique work is done, the implications of an advance may or may not be so profound. Still, and in contrast, the impact of a developmental advance that is achieved by everyone has little effect on a domain of knowledge, despite its profound effect on the child. A unique advance may alter for all time a field of study or a way of thought.

Crystallizing Conditions

An aspect of the equilibration process that also merits brief mention here pertains to the conditions under which developmental advances take place. Since we assume that (by definition) the advances in thought described by Piaget occur universally, it follows that the environmental conditions requisite for these achievements also occur universally.

It should be obvious that one of the ways in which Piagetian and non-Piagetian advances differ is in the specific crystallizing conditions under which they occur (Feldman, 1973a). At the least, we know that the conditions for the former are more pervasive, common and effective than the conditions for all others. The nature of the various kinds of nonuniversal environmental conditions has been taken up in Chapter 1; suffice it to say that all forms of advance are presumed to be achieved through some form of equilibration process. The circumstances which give rise to these processes may differ greatly, however.

UNIVERSAL AND UNIQUE: TWO POINTS ON A CONTINUUM

I have argued that the child who has initially achieved a Piagetian stage advance has, in some ways, had a similar experience to the individual who has found a totally new way to solve a problem at the frontier of a field. Everyone eventually climbs at least most of the Piagetian peaks, while few individuals create totally new and powerful landscapes. The child has changed his hard-won style of thought while the "creative" individual may have provided a solution with the power to change an entire field.

As already noted, the achievement of one of the universal advances or one of the steps in a sequence of such advances can be as profoundly moving as the achievement of a more lofty insight. The fact that universal intellectual advances are achieved by all individuals makes them no less significant to a particular individual at a particular point in his development. Acquiring more powerful rules and principles to organize experience are the inheritance of any human being in any human cul-

ture, but it is an inheritance that must be earned. Achievement of a universal advance is thus "creative" in the sense that it could not have been totally taught, that it has been constructed by the individual in response to a perceived problem needing solution, and that its achievement is often greeted with great satisfaction and delight. It is *not* creative, however, in terms of the impact it has on others, on a field of knowledge and action, or on a technology of communication, expression or practice (Salomon, 1974).

While the achievement of an advance may be subjectively much the same regardless of the particular level of accomplishment or field in which it occurs, the evaluation of that achievement by others varies greatly. Adults react with amused and knowing circumspection when they observe a child's realization that the transformation of clay into a ball and back into a long roll does not change the mass of clay. To the child this awareness may be a wondrous achievement, and so it is, but it is an achievement as common as walking.

How Picasso Paints a Picture: The Process View Applied

To illustrate how the notion of the creative process that I have described may operate within a discipline, I have chosen to consider in brief the manner in which Pablo Picasso went about producing a painting. The following is a passage taken from an interview in which Picasso reflects on his own creative processes:

> It would be very interesting to record photographically, not the stages of a painting, but its metamorphoses. One would see perhaps by what course a mind finds its way toward the crystallization of its dream. But what is really very curious is to see that the picture does not change basically, that the initial vision remains almost intact in spite of appearances . . . I perceive, when this work is photographed, that what I have introduced to correct my first vision has disappeared, and that after all the photographic image corresponds to my first vision, before the occurrence of the transformations brought about by my will. (Ghiselin, 1952, p. 56)

Picasso seems to be saying that he has a guiding image or vision in mind before he picks up paint and brush, before a single daub is placed on the canvas. Over the course of time what is put to canvas is intended somehow to match the template he had produced prior to beginning the painting. The original vision, according to Picasso, never really changes, but some of the transformations or, as he puts it, the "metamorphoses" of the painting represent closer and closer approximations to the original idea. The intention or "will" to render onto canvas that which is in the mind apparently does not succeed until the last try, at least for Picasso. The early products are in fact distortions of the vision; the will to produce that vision is able to achieve its purpose only by successive approximations, only by "stripping away" the irrelevant transformations.

Thus, Picasso completes a series of renderings which he tests against the image that guided their production. There is from the outset a sense (although an incomplete one, as we will see) of what the end result should look like. Presumably, the product eventually corresponds closely enough to the vision or template such that Picasso would say "Enough!"

This process, while it is not described in the rich detail it deserves,[5] seems straightforward enough in outline. The artist has an intention, which Picasso calls a vision, an aim to produce on a two-dimensional surface the image that he has somehow conjured up. He selects from the materials that are known to him those which he guesses are most likely to permit his intention to be carried out. He also selects from his tools and techniques those that appear most promising for transforming the materials into an organized whole. Having made these selections the artist then puts his first approximation into the concrete, real world of externally perceivable entities, for himself (and perhaps for others) to view.

At this point Picasso, whether explicitly or implicitly, consciously or unconsciously, decides if his tools and techniques have allowed him to produce a work close enough to the original intention or vision to be satisfactory. As Picasso says, generally these earlier attempts tend to distort rather than express the original image or vision. The painting is finished when it corresponds closely enough to the original intention for him to be satisfied. Perhaps a photograph of a painting permits the artist to finally see the painting as completed, whereas the painting itself may still reveal too much of its history. This point remains unclear, but from Picasso's report it does seem that a dynamic, ongoing process of comparison with an internal criterion continues until he is satisfied with the match of painting to "dream."

Picasso asserts that the painting as completed is an accurate expression of the original intention, that it corresponds to and expresses the image in a way that can be shared with others, and that it is satisfying to the person who produced it. While it may be going too far to say so, the motivation to produce the painting seems to be primarily a function of the desire to make explicit, or to express through a medium, a likeness of the imagined vision. Another source of motivation, obviously related, is the wish to communicate that vision to other individuals whose experi-

[5]See R. Arnheim's (1962) *The genesis of a painting: Picasso's Guernica* for a more detailed analysis of the development of Picasso's great mural.

ence permits them to share it with the painter. Thus, only the artist himself knows when the painting is complete.[6]

While this is probably an accurate enough outline of how Picasso guided the production of a work of art, there are a number of ambiguities that demand attention. One of these is the question of where the vision or image comes from in the first place. The second concerns the extent to which, if at all, that vision changes as a function of the attempts to express it through the particular form that intermediate products might take, or through other transformations that may occur between the original apprehension of the product and the decision, often much later, that the artist has done enough. Finally, there is the question of what happens when all of the materials, all of the tools, all of the techniques, and all of the wisdom and intuition that the artist has at his disposal are not capable of expressing the artist's vision. What happens then?

Each of these questions merits full and thorough consideration, but we will permit ourselves to touch upon only a few points.

From Where? To say that we do not know where an intention or image or vision comes from is to understate the case in the extreme. What we can say is that a vision depends upon the availability of at least somewhat satisfactory techniques to render it through a medium of expression. This is not to say that all people, including very young children, only have images when they are stimulated by a particular technique or method of expression. An image which a person uses to communicate with himself requires no externalizing medium, but an image which is to be communicated to others must somehow be expressed (Tyler, 1978). Incomplete images, or images which are not fully adequate to express the intention of the individual, may be refined through the use of a feedback process between mind and medium. This is in fact what I believe actually occurred in Picasso's description of "the manner in

[6]The viewer of the work perhaps experiences both the intention and its expression simultaneously, although in another part of the quoted interview Picasso suggests that each person experiences a painting in a unique way. Both could be true. Still, the most powerful works of art may be said to produce responses in viewers which the viewers did not know they had, to stimulate visions that were not spontaneously produced, to create intentions that are carried out and satisfied through appreciation of the work. Thus, the experience of the producer of a work is in some ways similar to, but in some ways very different from that of the appreciator of the work. Once a vision is present, an intention is perceived, the artist and the appreciator of art engage in many of the same activities. The artist produces an approximation on his canvas, and judges its adequacy to express or represent that vision. The appreciator or viewer of art judges the extent to which a product stimulates a response that the viewer did not know was there, creates intentions that were either disorganized or directionless, but obviously cannot judge the product in relation to a vision which preceded it (cf. Jackson & Messick, 1965; Bruner, 1962).

which the mind finds its way toward the crystallization of its dream." If an intention or vision were somehow complete and satisfactory there would be little need to express it through a medium, nor would there be a need to transform and reorganize materials until they take on a satisfying form.

My contention is that the original vision, although perhaps anticipated in outline, is lacking in crucial detail, and that in fact only its barest form is perceived at the outset.[7] The process that the artist goes through is one of consolidation or even *construction* of what is initially only a very sketchy notion.

In spite of Picasso's claim that a finished painting reflects the original vision, I think this is unlikely to be altogether true. What seems more likely is that Picasso had a general idea or intuition about what he would like to express through his medium. The medium itself was used to give further meaning to the intuition. What was produced on canvas became part of the vision, changing and informing it. Thus a vision, in the sense that we use the term, guides the use of materials, tools, and techniques; it permits the acceptance of some, the rejection of others, decisions about whether one is getting closer to or farther away from the original intention. But the vision itself changes subtly with each new attempt to express it.

Finally, product and vision become almost indistinguishable, and it is at this point that the vision has approximated the product and the product has approximated the vision. It is the individual compromising with himself. The medium is used to complete an incomplete intention, the expression of that intention is made possible through attempts to use a medium to represent it. Thus, while we cannot say precisely where visions or images come from, we can say that those visions are either incomplete, in which case they must be completed through the use of a medium of expression, or they are sufficient for the purposes of "internal" communication and need not be expressed through a medium of communication.[8]

Technique. The second issue concerns the particular set of techniques that are used by the artist. It should be obvious that disciplines

[7]This contention can be recognized as related to the "gestalt" view in psychology (cf. Arnheim, 1954).

[8]Einstein, when asked to describe how he thought about problems in physics, was unable to put into words the "internal language" he used: "the words or the language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The physical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be 'voluntarily' reproduced and combined . . . the above mentioned elements are, in my case, of visual and some of muscular type. Conventional words or other signs have to be sought for laboriously only in a secondary stage . . . (Ghiselin, 1952, p. 43).

have evolved to provide the means to express intentions and communicate "visions." The process through which one acquires the tools, techniques and wisdom of a discipline have not received serious attention in the psychological research literature, but it should be clear that creative work cannot be done except through the use of a medium of expression and communication. And these media cannot be acquired without hard, dedicated and persistent work. The act of painting allowed Picasso to feel the satisfaction of being able to complete a work. Other disciplines allow similar feelings in other ways.[9]

Visions, images and intentions seem to be produced from the whole range of experiences of an individual, but also to be constrained and limited by the particular media through which they are expressed. Einstein's intentions, however aesthetic, were probably best expressed through the discipline he had acquired. Similarly, Picasso's visions, however cosmic or mathematical, were probably those which could be best expressed through the medium of painting. Thus, it seems reasonable to conclude that the selection of a discipline is crucial both in terms of the kinds of images that one will be able to produce as well as the techniques available to represent (and construct) them.

Finally, we might ask what happens when a practitioner of a discipline, someone who wishes to express a "dream," has exhausted all the possibilities that his discipline offers and finds that the "original vision" (as Picasso put it) is still not captured in the product. When an individual reaches the limits of his craft, when all of the tools, techniques, materials and intuitions have been exhausted and the intentions of the worker still have not been satisfactorily expressed, then the conditions exist that seem to be requisite to the invention of a new technique for the expression of meaning. In other words, as long as an individual is able to express himself through the available forms in a medium there is little likelihood that new forms will be created.

Therefore, creative work of a more powerful sort probably comes about when a practitioner has reached the limits of his discipline. He must find a way to express an intention that guides him toward new combinations, different realms of experience, divergent domains, and other more radical searches for a way to fulfill the need for more complete representation of the vision that guided the whole process (Gruber & Barrett, 1974).

Mastery of a discipline or domain, of a way of dealing with certain problems, opens up at each level new problems to be solved, new experiences to assimilate, new techniques to master. This is as true for those

[9]In contrast to Picasso's feeling of satisfaction, Brewster Ghiselin (1952, p. 13) quotes young Van Gogh in a letter to his brother: "I am a prisoner in an I-don't-know-what-for horrible, horrible, utterly horrible cage . . . . Something is alive in me: what can it be!"

media through which we are all able to express ourselves tolerably well, such as language or arithmetic, as it is for media through which very few of us express ourselves, such as poetry or chess. When the level of mastery of a discipline, medium, or body of knowledge and skill reaches the point where a problem is perceived which is unprecedented and unique, there is nowhere to go but to new combinations—other media, other realms of experience—for leverage in solving it.

Although the specific elements used to solve the problem may come from various sources, there is enough of a sense of what it will be like when it is completed for the worker to be able to select and judge the appropriateness of each contending solution. Thus, the "shock of recognition" that is so often believed to follow a remarkable solution suggests that guided search in a well-mastered context makes the elimination of alternatives possible, the identification of a solution sure-footed, and the "recognition" a realization that a satisfying construction is at last complete.

A Developmental Analysis of the Thinking of Charles Darwin

The only published example I know of this kind of process approach to creative thinking is found in a book about Charles Darwin by Howard E. Gruber and Paul H. Barrett (1974). In this work Gruber traces the transformations in Darwin's system of thinking about evolution during the years 1837 to 1839 and shows that Darwin struggled with and essentially achieved the outline of the theory of evolution many years before it was eventually published in 1859. It would be impossible to capture in a summary the subtleties and complexities of Gruber's analysis, but a brief account of his discussion may enrich the view of creativity as process that is put forward here.

Gruber, too, has been influenced by Piaget, and he explicitly explores the relation between Piagetian universal thought structures and Darwin's highly unique ones. In a review of the Gruber–Barrett work (Feldman, 1975) I pointed out (as I have done in this chapter) that the analogy between Piagetian and creative thought advances is not an obvious one, yet Gruber makes a compelling case that Darwin's thought structures were transformed through a Piaget-like transition process. In particular, Gruber shows how various parts of the theory were present at more than one point in Darwin's formulations, only to drop out and later be resurrected when his overall organization of the field had advanced to the point where the old element could be more meaningfully integrated.

In some respects Gruber's attempt to trace the transformations in Darwin's thinking about evolution resembles our own attempt to analyze

the elements of the domain of map drawing (see Chapter 3). It is of course true that the field of evolutionary biology is much broader and more complex than map drawing. It is also true that we were organizing the existing domain of map drawing into developmental levels and discrete elements for a purpose different from Gruber's. Our purpose, it will be recalled, was to use a relatively well-defined problem as a basis for building a model of transition processes, i.e., to glimpse the set of movements that make up a developmental transition. Gruber's purpose in *Darwin on Man* was in this respect more akin to that of Chapter 2. Evolutionary theory could be seen as a major reorganization in a field of knowledge; Darwin's thinking, background and experience were the set of conditions giving rise to his novel interpretation of change in speciation. Still, the similarities between Gruber's approach to creativity and the approach proposed in this chapter are quite striking, as this passage illustrates:

> We know very little as yet of the process by which a new idea is produced. Let us suppose that each new variant is not an isolated idea but a change in the properties of some larger mental structure of which it is a part. Let us suppose, furthermore, that those parts of a system of ideas that are free to vary at any given moment are variable only within certain limits. This would be analogous to what we might say of any other part of a living system—that it is variable in its functioning, but within limits that depend on its place in the system as a whole.
>
> There are many things we do not know. How are individual ideas produced? Are new ideas common or rare? Are they recurrent or unique? In spite of all this ignorance, there are a few definite things we can say.
>
> A new idea can be recurrently new in one brain in the special sense that the first time it occurred it was not incorporated in a stable structure and therefore on a later occasion it *feels* new; or in the sense that its recurrence marks the transformation of some larger system, which did not occur the first time. The recurrence of the same novelty in the realm of ideas would be analogous to the repeated occurrence of the same mutation in the field of genetics . . . (Gruber & Barrett, 1974, p. 248–249).

The resonance of Gruber's analysis with our Chapters 2 and 3, as well as with this chapter, should be apparent. In particular, highlighting Darwin's overall purpose i.e., to formulate a better theory of evolution, is concordant with our notion of moving through the levels of a field until one reaches the limits of what that field can assimilate. For Darwin, of course, it was necessary to transform the field in order for it to accommodate the facts of nature as he perceived them: enormous variability among and within species, natural environmental forces influencing extinction and survival, qualities that remained stable despite changing conditions, chance, etc.

Gruber's treatment of novelty in Darwin's thinking as forming the "leading edge" of a configuration or system of ideas, too new to be useful until the overall system had ripened, bears close resemblance to our treatment of the role of novel elements in the transition process in map drawing. For Darwin, the concept of natural selection as a positive evolutionary force was a novelty which first occurred before he was able to use it, and again later, when he could appreciate its importance, and he seized it as a "missing element" in his theory (cf. Gruber & Barrett, 1974, pp. 103–106).

Map drawing and evolutionary biology are very different domains, to be sure. Darwin and the average ten-year-old are also very different in the systems of thought and the stores of knowledge available to them; they are pursuing different goals as well. The ten-year-old has begun to construct a hypothetico-deductive frame of reference within which to interpret aspects of the world that he or she has begun to perceive; Darwin organized his life around the goal of achieving a more powerful theory of evolution. Yet the achievements of both kinds of pioneer are in the family of developmental endeavors, sharing many of the same fundamental transition processes even as they reflect vastly different accomplishments. To spell out in detail the similarities and differences between the development of map drawing and of Darwin's work would require a chapter of its own where we could explore how this kind of case study approach illuminates the general process of creative thinking.

Missing from Gruber's account, of course, are the conceptual links between universal and unique (see Chapter 1) that make clearer the unique qualities of Darwin's thinking and the differences between thinking at the frontiers of a field and thinking at other levels and in other regions of developmental advance. Still, the Darwin analysis is a striking example of the value of a developmental process frame of reference for the understanding of creative thinking. By drawing attention to the developmental features of Darwin's thinking, Gruber has made a contribution to the understanding of all creative processes; it is this frame of reference that gives Gruber's work its power and its generality beyond the specific case. Obviously I hope that the extensions of developmental theory proposed elsewhere in this book and drawn upon in this chapter will enhance the viability of a process approach to the study of creativity.