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Predicting creativity from early to late adulthood: Intellect, potential, and personality

Gregory J. Feist^{a,*} and Frank X. Barron^{b,1}

^a *Department of Psychology, College of William and Mary, Williamsburg, VA 23187, USA*

^b *Department of Psychology, University of California, Santa Cruz, CA 95064, USA*

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Abstract

In 1950 (at age 27) a sample of 80 male graduate students was assessed on potential, intelligence–intellect, personality and creativity, and then personality and career outcome data were collected again at age 72. Intelligence (primary mental abilities, spatial, and number), intellect, potential, and personality (e.g., self-confidence, tolerance, openness, psychological mindedness, and introversion) at age 27 were expected to covary with creativity at age 27 and predict lifetime creativity at age 72. Yet, due to the non-intellective nature of personality, we predicted that personality would explain unique variance in creativity over and above that already explained by intellect and potential. Results supported each of these expectations. For instance, observer-rated potential and intellect at age 27 predicted lifetime creativity at age 72, and yet personality variables (such as tolerance and psychological mindedness) explained up to 20% of the variance over and above potential and intellect. Rank-order consistency coefficients revealed consistency over 44 years in some traits (e.g., psychological mindedness) and inconsistency in other traits (e.g., dominance). If traits function to lower behavioral thresholds in given situations, then the traits of self-confidence, openness, tolerance, and psychological mindedness (among others) may serve as a relatively direct link to creative behavior.

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1. Introduction

The question of which psychological variables early in life consistently and clearly foreshadow real-world creative achievement later in life is a terribly important one.

* Corresponding author. Present address: University of California, Davis, CA 95616, USA.

E-mail address: gjfeist@ucdavis.edu (G.J. Feist).

¹ Dr. Barron passed away on Oct. 6, 2002.

It is precisely this judgment for instance that businesses (R&D departments in particular) and members of graduate admissions and university job search committees routinely are being asked to make. Such judgments are anything but easy, and the question that begs to be answered is what psychological constructs best predict talent and achievement. The current investigation focused on three possible candidates and their relative importance: Intelligence, potential, and personality.

Intelligence, or learning and reasoning about new concepts quickly, efficiently, and easily, should be related to creative achievement. A related predictor of creative accomplishment may well be other people's judgments early in life about one's potential to make creative contributions later in life. In this case who the judges are and when in life those judgments are made will of course matter. But as both anecdotal and empirical evidence make quite clear, precocious intellectual talent cannot be the only factor influencing creative achievement (Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Eysenck, 1995; Jensen, 1996; Simonton, 1999a). Non-cognitive factors must play a role and the one that is the focus of the current investigation is personality. We present results of a study of the relative influences of intellect, intelligence, potential and personality on creativity that spans early to late adulthood. We hypothesize that intellect, intelligence, and potential in early adulthood will predict creative achievement in later adulthood, but that certain personality characteristics will explain variance in creative achievement over and above intellect and potential.

1.1. Intelligence–intellect and creativity

One of the more common-sense and intuitive conclusions concerning intelligence and creativity is that high level intelligence is synonymous with creative genius. Many people assume that if one has a very high IQ—for instance above 140—then one must be a “genius.” Before we address this assumption, let us first define our terms.

Intelligence is most often defined by experts as one's capacity, skill, or talent with three mental functions, namely information processing, problem-solving, and abstract reasoning (Snyderman & Rothman, 1987). Additionally more than 50% of the experts agree that intelligence also consists of memory capacity, adaptation to one's environment, mental speed, linguistic competence, mathematical competence, general knowledge, and creativity (Snyderman & Rothman, 1987). When defining creativity there also is a near consensus among experts in its two critical components: ability to generate both novel and adaptive (useful) solutions to problems (e.g., Amabile, 1996; Feist, 1998; Guilford, 1950; MacKinnon, 1970; Mayer, 1999; Simonton, 1988a; Sternberg, 1988). The novel and adaptive criteria also apply to finding, not simply solving, problems. Given these definitions of intelligence and creativity, it is clear that one way creativity can be conceptualized is as a subset of intelligence (cf. Sternberg & O'Hara, 1999). Intelligence is talent and skill with information processing, problem solving and abstract reasoning in general, whereas creativity is a specific capacity to not only solve problems but to solve them originally and adaptively. As defined, intelligence and creativity may be related but are not the same thing.

Moreover, empirically, one of the more robust findings in the intelligence–creativity literature is their moderated and relatively low degree of relationship. The general conclusion is that the two are moderately positively related (r of approximately $+ .20$ to $+ .30$) up to about 1 *SD* above the mean in IQ (approximately 115–120) and then the relationship becomes essentially zero (Albert & Runco, 1989; Barron, 1957; Barron & Harrington, 1981; Eysenck, 1995; Getzels, 1987; Gough, 1976; Helson & Pals, 2000; Jensen, 1996; MacKinnon, 1978; Simonton, 1999a; Sternberg & O’Hara, 1999; Torrance, 1980; Wallach & Kogan, 1972). This finding has now been dubbed the “threshold theory.” In summary, instead of being twin or even sibling constructs, intelligence and creativity may be more like cousins.

1.2. Potential and creativity

If intelligence per se is not enough to predict creative achievement, then perhaps precocious expression of intellectual talent (i.e., potential and/or giftedness) is. That is, people who are talented early in life, who have the most potential, may go on to make the most significant creative contributions. Potential early in life can be operationalized three ways: first as giftedness, second as early creative achievement, and third as judgment made by others.

First, with giftedness perhaps the best known example of a longitudinal study of creativity has been Terman’s (1925). The Terman study was conducted on over 1500 children (856 boys and 672 girls) who had a median IQ of 147 (in fact, the selection criterion was an IQ of 140 or more). The first sampling occurred in 1921 (when most of the children were about 10 years old), and then follow-ups took place in 1928, 1936, 1940, 1945, 1950–55, 1960, 1972, 1977, 1982, and 1986. One can see why this study has been called “the longest life-cycle study in the history of the social sciences” (Holahan, p. xi, in Holahan & Sears, 1995). Although the sample as a whole achieved higher than normal levels of education and career success (Holahan & Sears, 1995), if one uses standard creativity criteria (impact, productivity, and honors and awards), the Terman group in general was surprisingly uncreative over the course of their careers. No major writers, artists, or scientists emerged from this ‘genius’ level IQ group.

Another of the more ambitious and well-known longitudinal studies on giftedness is the Study of Mathematically Precocious Youth (SMPY) begun under the direction of Julian Stanley in the early 1970s (Stanley, 1998). This program targets children under the age of 13 who show precocious signs of mathematical talent, and has shown that many of these precociously talented youth do end up having remarkable careers in math and science. Furthermore, one of Stanley’s students, Benbow has reported data showing that precocious ability predicts achievement in high school (Benbow & Minor, 1986; Benbow & Stanley, 1982) and in college (Lubinski & Benbow, 1994). More recently, Benbow and colleagues (2000) reported that approximately 90% of the SMPY sample go on to get bachelor’s degrees, slightly less than 40% get master’s degrees, and about 25% receive doctorates. These figures are well above the base-rates for such degrees in the general population (with 23%, 7%, and 1% being the national figures, respectively).

Yet precocious talent and high probability of getting advanced degrees does not guarantee careers in math and science, much less highly creative careers. Benbow et al. (2000) also reported that averaged over two samples only about 20% of the males and less than 10% of the females who show extremely gifted talent for math as pre-adolescents even end up in math or science careers by their 30s. The percentage of those who stay in math and science and who make significant creative contributions to their fields would therefore have to be even much smaller.

Second, if potential is defined as actual early creative achievement rather than intellectual talent alone then the predictive value for lifetime creative achievement becomes much greater. One of the only gifted samples that was not defined by pure intellectual talent but rather by early creative accomplishment, Westinghouse semi-finalists, should show stronger signs of later creative achievement. The Westinghouse (now Intel) International Science Fair is the most competitive and prestigious high school science fair in the country and each year 300 semifinalists are chosen from a population of over 1200 entries, from which 40 ultimately become finalists. Subotnik and Steiner (1994) reported results of a 8-year follow-up to an investigation of 98 high school Westinghouse Science Fair finalists and semi-finalists of 1983. Eight years later, 49 of the 60 males (82%) but only 25 of the 38 females (66%) were still in science or science related fields (including graduate school).

In science another form of precocious creative achievement (i.e., publication), does regularly foreshadow continued levels of high creative achievement across one's lifetime (Cole, 1979; Dennis, 1966; Helson & Crutchfield, 1970; Horner, Rushton, & Vernon, 1986; Lehman, 1953; Over, 1989; Reskin, 1977; Roe, 1965; Simonton, 1988b, 1992). Those who are prolific early in their careers also tend to continue to be productive for the longest periods of time. For example, Horner et al. (1986) reported that the most prolific group of scientists out-published medium and low publishers by more than 2 to 1 in the 25–34 age period and they maintained about a paper per year advantage over both groups during each 10 year period until the mid 60 to 70 age period.

Third, potential for creative achievement can be evaluated explicitly by asking people closest to potential creators (i.e., family, friends, teachers, and acquaintances) to assess their potential for later creative achievement. When professors write letters of recommendation, for instance, they are being asked to not only assess a person's talents but also to predict how well this person will do in graduate school or as a new professor. Implicit, if not explicit, in this prediction is the question of creativity. The bottom-line question in academia in fact is whether a person will make a creative contribution to the field. Very few studies have directly examined explicit judgements of creative potential, the strategy adopted in the current study. The current investigation has creative potential ratings from graduate advisors and independently from a psychological assessment staff made 1–2 years prior to the PhD. Helson (1999) used similar techniques in assessing creative potential. In a longitudinal study of women, faculty members close to these women made explicit ratings of their creative potential when the participants were college seniors. Faculty ratings of potential distinguished those women who went on to have creative careers by age 43 from those who did not.

Creative potential, whether it is measured in terms of giftedness, precocious creative accomplishments, or observer-based ratings, should be related to later in life creative achievements. One sociological reason for this has been dubbed the “Matthew Effect” or cumulative advantage by sociologists of science (Merton, 1973). Those who achieve the most early in life set up a cycle of advantage: they get into the best universities, work with the most eminent mentors, get jobs at the top-tier institutions, get more grant money, attract the highest caliber student to work with them, and receive the most awards and honors (cf. Cole & Cole, 1973; Zuckerman, 1977).

Be this as it may, both intellect and potential are primarily intelligence-based criteria. Non-intellective criteria (such as personality and motivation) are also important predictors as they should be able to explain variance in creative achievement unique from intelligence. As Jensen (1996) recently argued in a chapter that intellectual giftedness is necessary but not sufficient for creative genius, “However, it might eventually be profitable for researchers to consider searching beyond high ability per se and identify personality indices that also will aid in the prediction of exceptional achievement. The proportion of those gifted youths selected for special opportunities who are most apt to be productive professionals in their later careers would thereby be increased.” (p. 409).

1.3. *Personality and creativity*

The effect of personality on creativity has been a well-researched topic over the last 50 years, in part due to the common interest that both personality and creativity have in individual differences. Theoretically, most every major personality theorist from Freud to Skinner has addressed creativity, and empirically, thousands of studies have examined all aspects of the topic, including personality. For instance, on average approximately 3500–4500 creativity references were added to the literature each decade from the 1970s to the 1990s (cf. Feist & Runco, 1993; Sternberg & Lubart, 1999).

In an attempt to summarize this burgeoning literature, a number of extensive reviews have been published on the creative person, product, and process (Barron & Harrington, 1981; Dellas & Gaier, 1970; Eysenck, 1995; Freeman, Butcher, & Christie, 1971; Gilchrist, 1972; MacKinnon, 1978; Martindale, 1989; Mumford & Gustafson, 1988; Simonton, 1999a; Stein, 1968). For example, in the early 1980s Barron and Harrington (1981), concluded in the *Annual Review of Psychology* that the most robust correlates of creative achievement were aesthetic sensitivity, broad interests, attraction to complexity, independence of judgment, intuition, high energy level, self-confidence, and creative self-concept. The most recent edition of the *Handbook of personality: Theory and research* (Pervin & John, 1999) included a chapter on “Creativity and genius” by Dean Simonton (1999a). Moreover, the field has advanced to the point that the first meta-analysis on the topic of creativity and personality was published in 1998 (Feist, 1998). The main conclusions from this meta-analysis were that creative people in general are more autonomous, introverted, open to new experiences, norm-doubting, self-confident, self-accepting,

driven, ambitious, dominant, hostile, and impulsive. Of these, the largest effect sizes were on openness, conscientiousness, self-acceptance, hostility, and impulsivity. Creative people in art and science do not completely share the same unique personality profiles: Artists are distinguished more by their emotional instability, coldness, and rejecting group norms than are scientists. Creative scientists exhibited very small effects on these socialization scales.

1.4. Longitudinal research on creativity and personality

The current study focuses on whether personality in early adulthood predicts creative achievement later in life, and whether personality predicts creative achievement over and above intellect and potential. Although one can argue for intellect and potential being subsumed under the rubric of personality, in this study we kept them separate and examined whether personality explained unique variance in lifetime creative achievement not attributable to potential and intellect.

A personality perspective on development addresses questions such as “How does creative behavior and creative disposition develop and progress over the life-span?” and “are the personality characteristics that distinguish highly creative young people the same that distinguish highly creative adults?” Research is relatively sparse on the topic, but in general the findings suggest personality traits of highly creative people are rather stable, whether they be architects (Dudek & Hall, 1991), artists, (Csikszentmihalyi & Getzels, 1973; Getzels & Csikszentmihalyi, 1976) or people in various professions (Helson, 1999; Helson & Moane, 1987; Helson & Pals, 2000; Helson, Roberts, & Agornik, 1995; Magnusson & Backetman, 1978). For instance, in terms of personality traits of the most creative subset of participants, Helson (1999) reported relatively high degrees of personality consistency over time, and yet significant covariation with changes in life circumstance. Moreover, strength and solidity of identity early in life appears to moderate the relationship between creative potential and creative achievement later in life, with those with the strongest identities and psychological mindedness showing the strongest relationships (Helson & Pals, 2000).

1.5. Hypotheses

First, based on the vast literature on intelligence and creativity and the smaller body of literature on potential and creativity, we predicted that tested intelligence as well as observer-rated intellect and potential should covary with creative ability and originality at age 27 and predict creative achievement at age 72.

Moreover, based on previous reviews of the literature on personality and creativity (e.g., Barron & Harrington, 1981; Eysenck, 1995; Stein, 1968) as well as a meta-analysis conducted by Feist (1998), we predicted positive relationships between creativity and the personality dimensions of self-confidence, self-acceptance, tolerance, openness, hostility, norm-doubting, achievement (drive and ambition), introversion, autonomy, and psychological mindedness. We also based the hypotheses on the longitudinal research on the creative personality, which in general suggests

a fair degree of stability in these relationships (e.g., Dudek & Hall, 1991; Helson, 1999; Magnusson & Backteman, 1978). These relationships should exist both at age 27 and at age 72. Because the current sample was roughly 80% from the sciences, we primarily focused on the reviews comparing scientists to non-scientists and creative to less creative scientists.

Finally, because the non-intellective (i.e., personality) variance should be somewhat independent of the variance explained by intellectual measures (i.e., intellect and potential), we also predicted that personality should explain unique variance in creativity over and above potential and intellect at ages 27 and 72.

2. Method

2.1. *Participants and procedures*

Because the original assessment has been described in detail in other publications (see Barron, 1954, 1963, 1968) we will only give summaries of some of the psychometric criteria and methodological procedures used in the 1950 assessment. In 1950 the names of 433 male graduate students were obtained from 14 departments of the Berkeley campus: Anthropology, Astronomy, Biochemistry, Botany, Business Administration, Chemistry, Economics, Entomology, History, Jurisprudence, Music, Physics, Plant Biochemistry, Political Science, and Zoology. Faculty members of these departments were given a list of their students who were thought to be within a year of obtaining their degree. For a student to be considered for the final study, at least six faculty advisor ratings were required on personal soundness, originality/creativity, and potential success. Eighty students eventually were selected for assessment, in groups of 10, for three days of interviewing, tests, and group procedures at the Institute of Personality Assessment and Research (IPAR) house. These activities included completing self-rated personality inventories, solving cognitive and perceptual tests, participating in group problem solving situations and improvisation skits, undergoing detailed life-history interviews, and having meals and other informal social interactions with staff members. From these relatively intensive interactions, staff made comprehensive evaluations of the Originality, Soundness, Potential and Personality of each participant, primarily using earlier forms of the Adjective Check List, California Q-sort, and various trait rating techniques (see Barron, 1963 & 1968 for more detail). The study was conducted in the Spring and Fall semesters of 1950, with 40 participants in each assessment period. The 1950 sample had a mean age of 27.

Of the original 80 participants 66 were still alive in 1994, nine could not be located, and four were uninterested in participating. The majority of the men who participated in the follow-up had very fond memories of the weekend assessment in which they took part in 1950 and were very forthcoming with providing us the follow-up information we requested. Of the 53 potential and interested participants, however, 10 failed to return fully completed personality measures (ACL, CPI, MMPI-2), so the final *N* for much of the personality data was 43. Objective life

history outcome information, however, such as type of career, awards, and honors were gathered on all but one of the original 80 participants, either from the participant's curriculum vita or from public directories such as *American Men and Women of Science* (AMWS). Publication data were found for 69 and citation data for 73 of the original 80. Although sample sizes between 43 and 73 are not large by criteria for power calculations (e.g., only medium to large effect sizes will be statistically significant), the relative smallness of the sample size is to be balanced against the richness (e.g., often a minimum of six different observers making personality ratings for each trait) and rarity of data: intensive psychological assessment at the beginning of one's career and then follow-up data 44 years later on career outcome and late-in-life personality.

Thirty-two (40%) of the 80 original participants went into academia after graduating (of which 37% were at major top-ranked research universities according to rankings by the National Academy of Sciences, 1983), 27 (34%) went into research, 12 (15%) went into business or law, and 9 could not be verified. In short, 59 of the original 80 (74%) became researchers or academics. The mean age at the follow-up was 72.05. At age 72, 6% classified themselves politically as extremely liberal, 19% as very liberal, 37% as somewhat liberal, 19% as middle of the road, 13% as somewhat conservative, and 6% as either very or extremely conservative, and 70% of the living participants were married.

2.2. Age 27 measures

Originality. Originality was assessed through a composite score created by *z*-transforming and then summing ratings made by at least three of the participants' graduate advisors, six psychological staff members,² and the participant himself. Staff members and departmental advisors rated each participant on a 4-point originality scale. These scores were then summed and *z*-transformed. Originality was defined as follows: "This refers to the student's freshness of vision and creativity of thought. . . original approach to problems in the field. Please consider that high success may be achieved without exceptional originality, just as originality does not guarantee success." Inter-rater reliabilities on these data were reported by Squier (1953) and were calculated by correlating the ratings made by three clinically oriented staff members against three non-clinically oriented staff members, and correcting by the Spearman–Brown formula. For originality the corrected reliability was .78.

Observer ratings of potential. Potential was assessed through a composite score that summed ratings made by at least three of the participants' graduate advisors, six psychological staff members, and the participant himself. The initial ratings were made on a 4-point scale, from "least promising" to "most promising." "Potential," was defined as follows: "This refers to the likelihood that the student will, in future

² Psychological staff in 1950 consisted of Donald W. MacKinnon*, Erik Erikson, Nevitt R. Sanford*, Robert E. Harris*, Richard Crutchfield*, Paul Dempsey*, Harrison G. Gough*, and Frank X. Barron. (* = present at both Spring and Fall assessments)

years, contribute significantly to his field, in some manner or another (theory, research, public service, writings, administrative work, etc.). The emphasis here is the person's general 'promise' in professional work. It need not imply widespread recognition of his merit, but it does involve the notion of real competence, of the sort that usually gets recognized and rewarded." As reported by Squier (1953) Spearman–Brown corrected reliability of the potential ratings was .84.

Intelligence: Thurstone's primary mental abilities (PMA). Although 5 of the 7 subscales of Thurstone's Primary Mental Abilities test (Thurstone, 1938) were administered to 40 of the original 80 participants, only the Spatial Ability (PMA-S) and Numerical Ability (PMA-N) subscales were administered to all 80 participants. PMA-S is the ability to think about objects in two or three dimensions, whereas PMA-N is the ability to work with figures-to handle simple quantitative problems rapidly and accurately. Although PMA-S and PMA-N were significantly correlated ($r = .40$, $N = 80$, $p < .001$) the magnitude of the correlation does not meet the rule-of-thumb threshold for convergent validity (.60) and therefore the two subscales were kept separate.

Observer ratings of intellect. The psychological assessment staff ($N = 6$) made numerous trait ratings on each participant after observing them over the course of the weekend's activities. They observed them in group activities (e.g., such as charades and meals), individually (e.g., in life-history interviews and informal one-on-one discussions), and in testing situations (such as Rorschach, perceptual-kinesthetic or aesthetic tasks). One of these trait ratings was "intellect," which was defined as "general intellectual ability, 'g', cortical power." This rating was made independently by six staff members on a 5-point Likert scale and then summed and z-scored to create a composite score on intellect. The Spearman–Brown corrected inter-rater reliability was .86 (Squier, 1953).

Observer ratings of personality: Adjective Check List (ACL). In 1950, either a 279 (Fall) or 284 (Spring) item version of the ACL was completed by six psychological staff members after each weekend assessment. The ACL was in early stages of development in 1950 and therefore its well known 37 scale scores had not been developed at that time. Instead, observer ratings of the six assessors were combined and converted to ratio scale scores on self-insight, judgability, intropunitiveness, likability, and total number of adjectives checked. For instance, self-insight was a ratio of ACL items checked in common by self and staff members divided by total number of self items. Judgability was the number of ACL items checked by two or more staff members divided by the total number of ACL items checked by at least one staff member. Likeability was calculated as the total number of favorable ACL items checked by staff divided by the total number of items checked by staff. Finally, intropunitiveness was calculated as the total number of unfavorable self and favorable staff items divided by the total number of favorable and unfavorable self and staff items. Observer-rated ACL data were preserved only in ratio scale rather than item form, so no proration to the current 37 scales was possible (as it was with the self-ratings on the ACL, see below).

Observer ratings of personality: Trait ratings. From a group improvisation activity and using a 5-point Likert scale, six raters rated each participant on the following:

Role Flexibility, which was defined as “the spontaneousness with which the subject enters into the role, the freedom of inhibition, and lack of rigidity in carrying out the role.” *Dominance* “the degree to which the subject takes the lead and the initiative in directing the improvisation, the extent to which developments are his choice of action.” *Poise and Balance* “Composure and stability in reacting to new twists in the improvisation, in adapting to change and surprise.” And *Ingenuity* “the degree to which a subject develops his role over and above what one would expect from the instructions alone. Highest ingenuity would give the impression of originality, distinctiveness, etc.” In addition to the improvisation-based ratings, general trait ratings were made by six psychological staff members and made on a 5-point Likert scale. Among these variables were: *Positive Character Integration*, defined as “conscientious, sense of responsibility, strong, internally determined principles, ethical sensitivity, sources of values are internal rather than social. Stability, strength, and resourcefulness under stress, self-reliance.”; *Deceitfulness*, defined as “guile, subterfuge, duplicity, lack of frankness.”; and *Vitality* “general energy level, stamina.” All observer-based trait ratings were summed across raters and z-scored and Spearman–Brown corrected inter-rater reliabilities ranged from .68 to .83 (Squier, 1953).

Self ratings of personality: CPI. As of 1950, only two CPI scales had been formally developed (Tolerance, To; reverse scored and called Prejudice, Pr) and Capacity for Status, Cs; (Gough, 1948, 1949). Nine other CPI scales were retroactively pro-rated in 1953 and scored for each of the 80 participants: Responsibility (Re), Flexibility (Fx), Dominance (Do), Femininity (Fe), Intellectual Efficiency (Ie), Achievement via Conformance (Ac), Psychological Mindedness (Py), Honor Point Ratio (Hr, later called Achievement via Independence), and Delinquency (De, later called Socialization). In addition, the CPI was scored on Potential Success (34 items), Originality (44 items), and Personal Soundness (48 items). Like the MMPI, the CPI scales were empirically constructed and items are not necessarily face-valid. Therefore, example items might be misleading. Psychometric information on the development of these scales can be found in various sources (Gough, 1948, 1949, 1952, 1953a, 1953b; Gough, McClosky, & Meehl, 1951).

Self ratings of personality: ACL. In 1950, either a 279 (Fall) or 284 (Spring) item version of the Adjective Check List was administered to each participant. All but one of the 279 or 284 adjectives on the 1950 version were on the final established 300 item version, so the item-overlap between the two versions was considerable. However, all of the current scales had not been developed at the time and yet data were preserved at the item-level, so the 1950 responses were prorated to the current 300 item version and each of the 37 raw scales. The raw scales could then be converted to T-scores with means of 50 and standard deviations of 10 (Gough & Heilbron, 1983).

Self ratings of personality: MMPI. The 566 item Group Form of the MMPI was administered only to each participant in the Spring sample ($N = 40$). However, three MMPI scales were administered to the Fall sample as well (Mf, K, and Ma) and therefore have an N of 80. In addition, two scales were scored later, namely ego-strength (Es, Barron, 1953) and hostility (Ho, Cook, & Medley, 1954).

2.3. Age 72 measures

Creativity. We gathered honor/award information either from the *American Men and Women of Science* and/or from the participants' curriculum vitae. One problem with such outcome information is how to standardize it across different disciplines. We therefore listed every award received by each person in a particular discipline (e.g., Anthropology, Business, Law, Chemistry, Physics, Music, and History) and mailed the list of awards broken down by discipline to a group of full professors ($N = 95$) at major research universities in the Midwest and Northeast and had them rate these honors, awards, and fellowships on a 1–10 prestige scale (see Table 1). We then took the mean value for the most prestigious honor or award a person received throughout his career, and the total number of fellowships, honors, and awards received throughout his career and z -scored each, and summed them. This linear combination became the "Awards" score.

Publication figures were gathered from two sources, participants CVs and/or *Science Citation Index*. Every attempt was made to count each publication (books, articles, chapters only) over the participant's entire career. Publication data for 69 of the original 80 participants could be found. As is inherently true with publication data, the distribution was positively skewed (Feist, 1997; Lotka, 1926; Price, 1963; Simonton, 1988b). In fact, Lotka (1926) was the first to propose a law that has been empirically validated many times: 50% of all publications are produced by only 10% of authors. The current sample had a mean of 39.22, a standard deviation of 65.16, a median of 9.00, a mode of 0.00 (13 of 69 had no publication), and a range from 0 to 253. The current sample also adhered to Lotka's law: 10% of the authors produced 55.7% of the total number of publications (1506 of 2706). Therefore, the raw data were transformed using a log base 10 transformation to normalize the distribution ($M = 1.00$, $SD = .80$) and all reported results using publication data were on the transformed scores.

Citation counts were gathered from the appropriate *Citation Index* catalog during the 5-year period between 1970 and 1974. A 5-year period in the middle of the participants' careers (mean ages were 47 and 52) was chosen partly because citation indexes did not exist before 1964 and partly because the stability coefficients between 5 year measures and lifetime measures is in the .80 to .90 range (Cole & Cole, 1973). Even more so with citation than with publication data, the distributions are inherently positively skewed (see Cole & Cole, 1973; Feist, 1993; Simonton, 1988a, 1988b). Complete citation data were found on 73 of the 80 participants, and produced a mean of 63.66, a standard deviation of 162.23, a median of 7.00, a mode of 0.00 (21 of 73 had no citation), and a range from 0 to 987. The top 5% of authors had 55.8% of all citations (2591 of 4647). Therefore, the raw data were transformed using a log base 10 transformation to normalize the distribution and all reported results using citation data use transformed scores. In addition to these separate indicators of lifetime creativity, we created a total lifetime measure by standardizing (z -score) and summing the scores on awards, publications, and citations into one score ("Lifetime Creativity").

Self ratings of personality: CPI. In 1994, the 462 item California Psychological Inventory (Gough, 1987) was administered to 53 of the original 80, and 43 completed

Table 1

Prestige ratings (scale from 1 to 10) made by a sample of 95 professors of the honors and awards with at least 10 raters

Honor/Award	Mean	SD	Min.	Max.	Raters
National Academy of Science, Member	9.41	1.32	2	10	71
Heinemann Prize	8.82	.98	7	10	11
National Academy of Engineering, Mem.	8.38	1.82	1	10	40
EO Lawrence Award	8.15	.99	6	9	13
Guggenheim Fellowship	7.85	1.68	4	10	95
American Economic Assoc., Fellow	7.45	1.29	6	10	11
American Academy of Arts and Sci., Fellow	7.17	1.79	4	10	18
NIMH, Fellow	7.09	2.17	3	10	11
Center for Advancement of Sci., Fellow	7.00	1.49	6	10	10
Nat. Endowment for Humanities, Fellow	6.87	1.93	3	10	16
Sloan Fellow	6.68	1.83	2	10	66
President Phi Beta Kappa	6.64	2.44	2	10	14
American Physical Society, Fellow	6.62	.96	5	8	13
NEA, Committee Member	6.50	1.75	4	9	16
Von Humbolt Senior Research Fellow	6.43	1.78	2	9	21
Fulbright Fellow	6.33	2.01	1	10	88
Yale University, Visiting Professor	6.27	2.22	2	9	15
Director of Off-Broadway Production	6.08	1.68	4	8	12
Norwood Prize	5.91	2.34	1	9	11
NSF, Predoctoral Fellow	5.83	2.01	2	9	53
NSF, Postdoctoral Fellow	5.81	1.88	2	9	57
AAAS, Fellow	5.43	2.33	1	9	51
Phi Beta Kappa, Member	5.26	2.49	1	10	93
Ecol Polytechnic, Visiting Scholar	5.25	2.70	1	9	12
UC Berkeley, Visiting Professor	5.00	2.42	1	8	30
University of Minn. Book Prize (1st place)	4.64	1.91	2	8	14
Columbia University, Visiting Professor	4.54	1.98	1	8	13
President Delaware Opera	4.50	1.27	1	6	10
Stanford University, Visiting Scholar	4.45	2.30	1	8	11
Cornell University, Visiting Professor	4.42	2.19	1	8	12
Stanford University, Outstanding Teacher	4.21	1.25	3	7	14
Distinguished Alumnus	4.08	1.98	2	8	12
University of Minn., Outstanding Alum	4.00	1.05	2	6	10
UCLA, Visiting Professor	3.75	1.81	1	6	16
Southwestern AA, President	3.73	2.22	1	7	15
American Anthropol. Assoc., Fellow	3.65	2.47	1	8	17
American Geological Society, Fellow	3.40	2.01	1	7	10
Washington Univ, Visiting Assoc. Prof.	3.15	1.41	1	5	13
NY Academy of Science, Member	3.04	2.39	1	9	52
Sigma Xi, Member	2.82	1.79	1	9	74
Office Manager, Oregon	1.82	.87	1	3	11
Arkansas Academy of Science, Member	1.57	1.13	1	4	10

inventories were returned. In addition to the 18 traditional CPI scales (e.g., Dominance, Sociability, Tolerance, Flexibility, etc.), the 1987 version of the CPI is scored on two new scales (Empathy and Independence) and three vectors (Internality, Norm-Questioning, and Realization). Because they play a prominent role in the

current study, Tolerance (To) and Psychological Mindedness (Py) will be described in more detail. The To scale was initially developed to measure authoritarianism and intolerance. High scorers are tolerant of other's beliefs and values, even when different from one's own and are fair-minded. Low scorers are distrustful, fault-finding, and vindictive (Gough & Bradley, 1996). Psychological-mindedness (Py) was initially designed to distinguish those who would from those who would not be interested in and have talent for working in the field of psychology. High scorers are insightful, intellectual, perceptive, and understanding but not necessarily supportive, whereas low scorers are more interested in practical and concrete rather than abstract matters, and are somewhat apathetic (Gough & Bradley, 1996).

Self ratings of personality: ACL. The 1983 version of the ACL was administered and complete data were collected on 43 of the 53 to whom the scale was sent (Gough & Heilbron, 1983). The responses were scored on a total of 19 need scales (e.g. Dominance, Achievement, Endurance, etc.), nine topical scales (e.g., Counseling Readiness, Creative Personality and Ideal Self), five transactional scales (e.g., Critical Parent, Nurturing Parent), and four orignce-intellectence scales. In sum, the ACL is scored on 37 scales, which are converted to T-scores with means of 50 and standard deviations of 10.

Self ratings of personality: MMPI-2. The revised 1989 567 item version of the MMPI was administered in the follow-up (Hathaway & McKinley, 1989). In addition to the traditional L, F, K, and 10 scales, the MMPI-2 was scored on Ego-strength (Es, Barron, 1953) and Hostility (Ho, Cook, & Medley, 1954).

3. Results

3.1. Construct and predictive validity of creativity measures

Publications, citations, and number and prestige of awards all converge at acceptable levels of construct validity (see Table 2). The various age 27 ratings by staff, advisors, and self on originality, however, for the most part do not covary/predict Lifetime Creativity measures. Only the overall composite (staff, advisors, and self) on Originality predicts the number and prestige of Awards. Age 27 originality ratings covary in the expected direction with Lifetime Creativity measures, but the effect sizes are simply too small to be detected at statistically significant levels.

3.2. Planned analyses

Recall the major predictions that both intellect and potential as measured at age 27 will covary with originality at age 27 and predict lifetime creative achievement at age 72. Moreover, based on the meta-analytic results of Feist (1998) the predictions of personality were as follows: The more creative compared to less creative participants should have elevated scores on Confidence, Dominance, Openness, Tolerance, Introversion, Intelligence, and Flexibility, and these should predict Creativity over and above variance already accounted for by Potential and Intellect. Specifically,

Table 2

Construct/convergent and predictive validity of age 27 originality ratings: Correlations with lifetime productivity and awards

	Publications	Citations	Awards
<i>Convergent validity</i>			
Publications			
Citations	.72***		
Awards	.63***	.55***	
<i>Predictive validity (age 27)</i>			
Overall Originality Composite	.18	.21	.29**
Staff Originality Composite	.09	.15	.24*
Advisor Originality Composite	.14	.17	.21
Self-rated Originality	.20	.17	.20

Note. *N*s range from 62 to 72.

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$.

staff and self ratings on these dimensions should be elevated for the more creative participants in the sample. CPI scores on Tolerance, Self-acceptance, Flexibility, Dominance, Intellectual efficiency, Achievement via Independence, and Psychological Mindedness should all be elevated, whereas their scores on Sociability should be depressed. Similarly, scores on the Adjective Check List (ACL) scales of Autonomy, Dominance, Self-Confidence, Endurance, and Achievement should be elevated, and the scale scores on Abasement should be depressed. Because the ACL and portions of the CPI and MMPI were administered at both time periods, we have concurrent relationships (age 27 personality and creativity and age 72 personality and creativity) and predictive relationships (age 27 personality with age 72 creativity) to examine. Finally, we predicted the variance in creativity that personality explains would be somewhat independent from the variance in creativity that intellect and potential explain.

Age 27 personality with age 27 creativity. Using an α level of $\leq .05$ and with an *N* of 79, the largest concurrent effects of personality on creativity (Originality Composite) at age 27 were for the Potential Composite (advisors, staff, and self composite, $r = .78$, $N = 70$), staff ratings of Intellect ($r = .71$), and Psychological Mindedness ($r = .42$). Other personality correlates included Submissiveness ($r = -.35$), Confidence ($r = .34$), Self-Assurance ($r = .32$), and Tolerance ($r = .27$). The creative graduate student showed a lot of potential and was perceived as intelligent and intellectual by others and was psychologically minded, self-assured, confident, and tolerant.

In order to assess the independence of personality at age 27 in co-varying with originality at age 27, we conducted a setwise hierarchical multiple regression analysis, with the Potential Composite, Thurstone's PMA-Spatial and observer-rated (staff) Intellect entered in the first step and thereby held constant (see Table 3). Potential, Spatial Ability, and Intellect explained 67% of the variance in the Originality Composite. And yet the personality variables of Self-Confidence and Submissiveness

Table 3

Setwise hierarchical multiple regression model of age 27 predictors on age 27 creativity (originality composite)

Step	Predictors	<i>r</i>	<i>sr</i> ²	<i>t</i>	<i>R</i> ² Δ	Cum. <i>R</i> ²	<i>F</i> ^a
1	PMA-Spatial	.29	.000	.22			
	Intellect (Staff)	.71	.055	3.52**			
	Potential Composite	.78	.164	6.09***	.67	.67	50.56***
2	Self-Confidence	.34	.064	−4.32***			
	Submissiveness	−.35	.034	−3.13***	.08	.75	11.35***
	All variables					.75	43.25***

^a *F*-values are calculated for the significance of each set; *N* = 79.

** *p* ≤ .01.

*** *p* ≤ .001.

explained a significant 8% increase in variance explained over and above Potential and Intellect.³

Age 27 personality with age 72 (Lifetime) creativity. For Lifetime Creativity three separate indicators were assessed—publications, citations, and prestige and number of awards—and these were *z*-scored and summed into the Composite Lifetime Creativity score. In general, personality most consistently predicted citations and awards, with 12 out of 26 and 11 out of 26 predicted relationships reaching statistical significance, respectively (see Table 4). Only 2 of the 26 predicted relationships between personality and publications were statistically significant. If one equates citations with quality of work and publication with quantity of work (Feist, 1997), then personality is more predictive of quality than quantity of work. More specifically, the largest magnitudes of zero-order effects between personality and citations were for CPI Tolerance, Staff Potential, Potential Composite, and CPI Intellectual Efficiency. The largest effects between personality and awards were on the CPI scales of Psychological Mindedness and Tolerance, the Potential Composite, and staff rated Intellect and Values Intellectual Pursuits. The picture these correlates paint of the creative graduate student is one who is seen by others at age 27 as having great potential and general intelligence, and who sees himself as being tolerant and open to other ways of thinking and able to keep on task.

The setwise hierarchical multiple regression analysis revealed that although the Potential Composite, Observer-rated Intellect, and PMA-Spatial explained a significant amount of variance (14%) in the Composite Lifetime Creativity measure when entered in the first step, the personality measures of Tolerance and Psychological Mindedness explained an additional 20% increase in variance over and above these two measures (see Table 5). In other words, holding Potential, Spatial Ability, and Intellect constant, the two personality measures (Tolerance and Psychological

³ Because the zero-order correlation between self-confidence and originality is positive and yet its standardized regression coefficient weight is negative (as seen in the negative *t*-value in Table 3), self-confidence is a suppressor variable. But in this context the suppression is an artifact of the other predictor in step 2 (submissiveness) being negatively correlated with the originality outcome. In short, for a given score on originality, the lower the score on self-confidence the higher the score on submissiveness.

Table 4
Relationships between age 27 potential and personality with age 72 creativity measures

1950 Potential/personality variable	Rater	Creativity rating			
		Publications <i>N</i> = 68	Citations <i>N</i> = 70	Awards <i>N</i> = 71	Lifetime <i>N</i> = 55
<i>Predicted relationships</i>					
Potential	Advisors/Dept.	.11	.20	.27*	.24
Potential	Psychological Staff	.17	.33**	.29**	.32**
Potential	Self	.01	-.03	.08	-.03
Potential Composite	Dept./Staff/Self	.19	.32**	.35**	.35**
Intellect	Observer/Staff	.19	.27*	.32**	.32**
PMA-Spatial	Test	.13	.03	.07	.13
PMA-Number	Test	-.08	.17	.07	.04
Intellectual Competence	Observer/Staff	.04	.09	.28*	.13
Values Intellectual Pursuits	Observer/Staff	.17	.26*	.32**	.28
Self-Assurance	Observer/Staff	.13	.26*	.20	.13
Submissiveness	Observer/Staff	-.09	-.07	-.09	-.02
Dominance	Observer/Staff	-.12	-.11	-.04	-.17
Confidence	Observer/Staff	.05	.22*	.16	.12
Flexibility	Observer/Staff	-.09	-.01	.10	-.02
Impulsivity	Observer/Staff	-.18	-.24*	-.07	-.19
Tolerance	Self/CPI	.32**	.43***	.35**	.50***
Psychological Mindedness	Self/CPI	.21	.26*	.37**	.37**
Intellectual Efficiency	Self/CPI	.18	.29**	.25*	.30*
Achievement via Independence	Self/CPI	.19	.24*	.17	.26*
Achievement via Conformity	Self/CPI	.10	.20	.27*	.17
Flexibility	Self/CPI	-.03	-.10	.04	-.10
Dominance	Self/CPI	-.08	-.00	.16	.01
Abasement	Self/ACL	-.27*	-.18	.07	-.20
Achievement	Self/ACL	.03	-.03	.14	.04
Autonomy	Self/ACL	.11	.23*	.05	.18
Dominance	Self/ACL	.07	.07	-.12	.02
Endurance	Self/ACL	-.02	-.05	.26*	.04
Self-Confidence	Self/ACL	.08	.06	.02	.07
<i>Post hoc relationships</i>					
Positive Character Integration	Observer/Staff	.37**	.30**	.21	.37**
Judgability	Observer/ACL	.35**	.20	.22	.35**
Self-Insight	Observer-Self/ACL	.34**	.22	.28**	.34**
Good Judgment	Observer/Staff	.33**	.36**	.30**	.33**
Likability	Observer/ACL	.33**	.33**	.29**	.33**
Deceitfulness	Observer/Staff	-.26*	-.23*	-.06	-.26*
Vitality/Energy level	Observer/Staff	.22	.18	.27*	.22
Mania	Self/MMPI	-.54**	-.39*	-.38*	-.54**
Hostility	Self/MMPI	-.42**	-.35*	-.43*	-.51**
Mania-K corrected	Self/MMPI	-.30*	-.15	-.17	-.30*
Ego-strength	Self/MMPI	.19	.34*	.20	.27

Note. *N*s for Self/MMPI ranged from 31 to 71. PMA = Primary Mental Abilities; CPI = California Psychological Inventory; MMPI = Minnesota Multiphasic Personality Inventory; ACL = Adjective Check List.

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$.

Table 5

Setwise hierarchical multiple regression model of age 27 personality predictors on age 72 creativity (Lifetime composite)

Step	Age 27 predictors	<i>r</i>	<i>sr</i> ²	<i>t</i>	<i>R</i> ² Δ	Cum. <i>R</i> ²	<i>F</i> ^a
1	Potential Composite	.35	.038	1.52			
	PMA-Spatial	.13	.000	.21			
	Intellect (Staff)	.32	.001	.73	.14	.14	2.74*
2	Tolerance (CPI)	.50	.147	3.32**			
	Psychological Mindedness (CPI)	.38	.050	1.96*	.20	.34	7.60**
	All variables					.34	5.11***

^a *F*-values are calculated for the significance of each set; *N* = 55. PMA = Primary Mental Abilities; CPI = California Psychological Inventory.

* *p* ≤ .05.

** *p* ≤ .01.

*** *p* ≤ .001.

Mindedness) are still significant predictors of Lifetime Creativity, both individually and as a set. In fact holding all other predictors constant, Tolerance alone uniquely explains 15% of the variance (*sr*² = .147) in the Lifetime Creativity measure.

Moreover, as testimony to the relative strength of personality compared to intellect and potential in predicting lifetime creativity, the setwise regression was re-run, but with personality entered in the first step and potential and intellect entered second. Indeed, the personality set (Py and To) explained 33% of the variance (*F*(2, 52) = 12.98, *p* = .000), whereas the potential–intellect set (PMA-Spatial, Potential Composite, observer rated Intellect) only added 1% additional variance (*F*(3, 49) < 1.0, ns). In other words, intellect and potential added nothing above and beyond personality in predicting creativity.

Age 72 personality with age 72 creativity. Finally, the concurrent relationships between age 72 personality and age 72 creativity revealed that the four predictors explained 41% of the variance in Lifetime Creativity outcome (*F*(42) = 6.29, *p* < .001); Social Presence explained uniquely 7% (*sr*² = .074) of the variance, whereas Independence (In), Achievement via Independence (Ai), and Self-Control (Sc) explained uniquely about 3%, 2%, and 1% of the variance, respectively.

Rank-order consistency of creative personality traits. As stated at the outset of the paper, one purpose of the present investigation was to examine developmental changes in creative disposition over the life-span. In addition to looking at predictive relationships between personality and creative achievement, another strategy is to examine how consistent creative people are in their dispositional qualities by means of rank-order consistency coefficients. Analyses of rank-order consistency are obtained by computing test–retest correlations and transforming them using Fisher's *Z* transformation procedure (Roberts & DelVecchio, 2000). The *Z* transformations put the correlations on a less biased and more normalized distribution (Hedges & Olkin, 1985). Rank-order consistency coefficients were calculated on CPI, ACL, and MMPI creativity-relevant scales that were measured at age 27 and again at age 72 (not all scales were available in 1950). As can be seen in Table 6, some traits

Table 6

Rank-order consistency (test–retest correlations) between creativity-relevant traits measured at age 27 and age 72

Inventory	Scale	<i>rZ</i>	<i>N</i>
CPI	Tolerance	.23	43
	Psychological Mindedness	.60	43
	Intellectual Efficiency	.47	43
	Achievement via Conformity	.27	43
	Achievement via Independence	.59	43
	Flexibility	.60	43
	Dominance	.21	43
ACL	Abasement	.11	37
	Achievement	.14	37
	Autonomy	-.14	37
	Dominance	-.10	37
	Endurance	.02	37
	Self-Confidence	.01	37
MMPI	Mania	.61	42
	Hostility	1.22 ^a	20
	Ego-strength	.17	20

^a *Note.* Fisher's *r* to *Z* transformations normalize the distribution of *r* and allow for *rZ* values greater than 1.00. An *rZ* value of 1.22 is equivalent to a test–retest correlation of .84.

exhibit high rank-order consistency whereas others do not. In general, the CPI and MMPI creativity relevant traits are fairly consistent over time and the ACL traits are not. Specifically, some predictors of creative achievement showed remarkable stability over a 44-year period, such as CPI-Py, CPI-Fx, CPI-Ai, MMPI-Ma, and MMPI-Ho. These results suggest that individuals relatively high or low on psychologically mindedness, flexibility, achievement via independence, mania, and hostility early in life remain so later in life. However, other creative dispositions showed much more change over time, namely CPI-To, CPI-Do, CPI-Ac, MMPI-Es, and each of the ACL scales (Abasement, Achievement, Autonomy, Dominance, Endurance, and Self-confidence). For instance, people high in tolerance, dominance or self-confidence at age 27 were not necessarily still relatively high on those dimensions at age 72.

3.3. *Post hoc analyses*

In studies this rich in data, there are many unexpected results in need of replication. In the age 27 concurrent analyses, quite a number of observer-based personality ratings unexpectedly correlated with the Originality Composite scores. Large effect sizes (i.e., in the .50 range; Cohen, 1988) were obtained on the staff ratings between the Originality Composite and Productive Achievement (i.e., intrinsic motivation, $r = .59$) and Breadth of Interests ($r = -.58$), suggesting that the most creative 27-year-old students were seen as being driven by intrinsic motives and having a wide range of interests. In addition, original students were seen by psychological staff

as not being Gullible/Suggestible ($r = -.42$), having Good Judgement ($r = .36$), and being Aesthetic ($r = .36$), Self-Insightful ($r = .34$), and Self-Assured ($r = .31$).

The participants who ended up being the most creative over their careers were unexpectedly distinguished by a number of individual difference measures at age 27: they were rated by staff as having sound judgment, being likeable and self-insightful as well as being conscientious and emotionally stable (positive character integration). In addition they rated themselves at age 27 as being relatively low in Hypomania (Ma, MMPI, $r = -.51$) and Hostility (Ho, MMPI; $r = -.30$).

The last set of post hoc results at age 72 already have been partially discussed under the regression analysis. All of the following correlations had an N of 40 and obtained p -values of less than .05. Self-Control ($r = .45$), Independence ($r = .40$), and Social Presence ($r = -.44$) at age 72 each correlated with Lifetime Creativity, so too did the CPI scales of Responsibility ($r = .32$), Good Impression ($r = .40$), and the vector score of Realization ($r = .36$), the ACL scales of Heterosexuality ($r = -.31$), Low-Origence/Low Intellectence ($r = -.33$), and the MMPI scales of Paranoia, Mania ($r = -.41$) and Hostility ($r = -.36$). The participants who became the most creative over the course of their lives, were self-controlling, independent, self-assured, spontaneous, responsible, tried to make a good impression on others, relatively low in hypomania and hostility.

4. Discussion

At once a very consistent and yet complex picture of the creative person emerges from this 44-year longitudinal investigation into the creative personality. In early adulthood, there are quite a few signs pointing towards expressed talent and creative achievement, and these are observable and recognizable by others, in this case, by faculty advisors and psychological staff members. Potential was rated by six advisors and six staff members as well as the participants themselves. Ratings on potential made at age 27 by both graduate advisors and psychological assessment staff do indeed have predictive validity. Potential ratings strongly covary with originality at age 27 and more moderately predict creative achievement over the lifetime (i.e., publications, citations, honors, and awards).

Observer-rated intellect at age 27, as predicted, was related to originality at age 27 and to creative lifetime achievement at age 72. Tested intelligence, however, as measured by Thurstone's Primary Mental Abilities test had much weaker relationships with creativity at both age 27 and 72. In fact, the only significant zero-correlation between either PMA subscale and creativity was the Spatial subscales' correlation with age 27 originality. Observations of intellect made by skilled assessors have more predictive validity than tested intelligence in forecasting creative achievement. In short, these results replicate other studies in showing that potential, intelligence and intellect were moderately strong predictors of creative achievement (Barron, 1957; Barron & Harrington, 1981; Bleier, 1988; Helson & Pals, 2000; Magnusson & Backteman, 1978; Simonton, 1987; Sternberg, 1988).

The focus, however, of this study was the power of personality to predict concurrent and lifetime levels of creative achievement. Hierarchical regression allowed this question to be asked in a more focused manner, by determining whether personality explained variance in creativity once potential and intellect had been statistically held constant. It does. At age 27, personality (self-confidence and submissiveness) predicted concurrent creative achievement over and above potential and intellect, increasing variance explained by 8%. Additionally, age 27 personality also explained variance in lifetime creativity (age 72) over and above potential and intellect. Two measures of personality—CPI scales on Tolerance and Psychological Mindedness—resulted in a significant increase in variance explained (20%) over and above potential and intellect. The more tolerant and psychologically minded the student was, the more likely he was to make creative achievements over his lifetime. Together, the four predictors (Potential, Intellect, Tolerance, and Psychological Mindedness) explained a little more than a third of the variance in lifetime creative achievement. We should point out that these findings on To and Py mirror very closely those reported by Helson and Pals (2000) on a sample of women from age 21 to 52. In fact, Helson and Pals argue that To and Py are two main components of psychosocial maturity and that women with creative potential at age 21 but without clear identity and psychosocial maturity at age 43 are not likely to actualize their creative potential by age 52.

Certain concurrent personality variables at age 72 tended to explain variance in creativity as well. Four CPI scales—Social Presence, Independence, Achievement via Independence, and Self-Control—each had zero-order correlations above .40 with creativity and together explained 41% of its variance. Social Presence (Sp) was a negative predictor, and as described by Gough (1987) high scorers on Sp are self-assured, spontaneous, good talkers, and not easily embarrassed, whereas low scorers are cautious, hesitant, and not sarcastic. Although with a negative correlation it is tempting to conclude that creative people in this sample are “cautious, hesitant, and not sarcastic” it is necessary to first examine the mean level on Sp before making such an inference. If we dichotomize Lifetime Creativity at the median and examine the high and low means on Sp, we see that in fact it is more of a slightly elevated score of the low creative group that leads to the negative correlation (Low $M = 56.17$; High $M = 48.31$). Therefore, a more accurate interpretation of the negative correlation would be that those who achieve less in this sample are more likely to be self-assured, spontaneous, and good talkers than those who achieve more. Likewise, the positive correlations on Independence, Achievement via Independence, and Self-Control, when put in the context of the means on the two groups, suggest that both groups were relatively high on In (Low $M = 55.89$; High $M = 60.00$), Ai (Low $M = 59.32$; High $M = 63.91$), and Sc (Low $M = 55.63$; High $M = 63.05$), but that the more creative men are simply higher than the less creative men.

Somewhat surprising, finally, were the relationships between various observer-rated “likeable” personality characteristics at age 27 (e.g., likeable, tolerant, positive character integration, sense of humor, and low deceitfulness) and achieved creativity at ages 27 and 72. These findings contradict other studies that have reported arrogance and hostility to be associated with creative scientists (e.g., Feist, 1993). One

difference worth noting in the two studies is the level of eminence was more restricted (at the high end) in the earlier study by Feist, whereas the current sample, although quite successful, had more variability in career type as well as success. For instance, 15% of the current sample was in business or law and only 40% were in academic positions (the rest were doing commercial research), whereas in Feist (1993) the entire sample consisted of full professors at major research universities (one-third of whom were members of the National Academy of Sciences). Nevertheless, the varying patterns of results between the studies are intriguing and call out for more explicit hypothesis testing of possible moderating effects between personality and creativity.

One desired outcome of the current research is that it may begin to fill in the as yet unspecified components that predict talent in multiplicative models (Jensen, 1996; Simonton, 2000; Wahlberg, Strykowski, Rovai, & Hung, 1984). That is, talent is based on the convergence of many normally distributed domains that are each necessary but not sufficient for creative achievement. If a person is missing even one talent domain then creative potential is zero, because there is a zero in the left side of the equation. That is, creative achievement occurs when, and only when, one has *all* of the requisite components at at least a moderately high level. Indeed, there is much evidence for extremely positively skewed distributions in talent domains, such as publications, patents, awards (Cole & Cole, 1973; Feist, 1993; Price, 1963; Reskin, 1977; Simonton, 1988a; Wahlberg et al., 1984). The key question in such models is what components should go into the multiplicative model predicting talent and achievement. The current investigation provided evidence for three possible candidates and their relative importance, namely intelligence, potential, and personality.

4.1. Mechanisms linking personality and creativity

The traditional trait summary approach (i.e., reporting personality correlates of creative groups of people) is a needed first step in establishing the covariation between personality and creative behavior. Covariation, after all, is a necessary if not sufficient condition for causality. Major shortcomings, however, to the empirical trait-summary approach include its silence on plausible mechanisms linking personality and creativity as well as on the issue of developmental change over the life-span (cf. Block, 1995; Mischel, 1968; Pervin, 1994). The current study was an attempt to address these shortcomings, developmental change in particular. The findings from the current study will only allow us to speculate as to what some of the plausible mechanisms linking personality and creativity may be, but we do offer some possibilities.

One possible link is that traits function not so much as causal agents on behavior but to lower behavioral thresholds. As many others have argued, the primary function of traits is to lower thresholds for trait congruent behavior in given situations (Allport, 1937; Ekman, 1984; Eysenck, 1990; Funder, 1991; Rosenberg, 1998). For instance, being high in trait hostility functionally lowers one's threshold for anger and/or aggressive behavior. Because a functional threshold view argues for the interaction between traits and situations, dispositions expand the number of situations in

which a given trait congruent behavior will be expressed. If traits function to lower behavioral thresholds in given situations, and possessing a cluster of “creative personality traits” lowers one’s threshold for creative behavior, then the traits of self-confidence, openness, tolerance, and psychological mindedness (among others) may serve as a relatively direct link to creative behavior.

Creativity also appears to be a result of cognitive as well as affective richness and openness. Purely cognitive approaches have argued for the connection between ideational fluency and creativity. Mendelsohn (1976), for instance, has shown that broad, rather than narrow, attention searches predict creative anagram solutions. Mednick’s (1962) theory of remote associations underscores the associational richness of creative thinkers. Guilford (1950, 1968) built a theory of creativity around ideational fluency, flexibility, and originality. Finally, perhaps most well known is Simonton’s chance configuration theory of creativity, which posits ideational and associational fluency as the foundation for creative achievement (Simonton, 1999b). More direct empirical tests of these mechanisms are needed before the size of their effects can be established.

4.2. Limitations of the current investigation and future directions

There are at least three limitations of the current investigation that lessen its generalizability or external validity. First, the sample included men only and therefore says nothing directly about the patterns and trends that may exist for women. As was more common in the 1940s and 1950s, this investigation focused on men and must remain silent on women. Fortunately, other investigators have recently conducted research on women (Helson, 1999; Helson & Pals, 2000; Helson et al., 1995), on architects (Dudek & Hall, 1991), and on young scientists (Subotnik & Steiner, 1994), and in general it would appear that these studies are consistent with the current study’s basic findings, which attenuates some of the current study’s possible external validity limitations. What is particularly encouraging is the overlap between the current findings and those of Helson and Pals (2000) in terms of personality and potential predictors of creative achievement 30 or more years later in life. Tolerance and psychological mindedness, for instance, consistently appear as some of the strongest predictors of lifetime creative achievement. Second, the study would be on stronger empirical grounds had there been multiple waves of data rather than just two (age 27 and age 72). The initial study, however, was not intended to be the first wave of a longitudinal study and therefore mid-life follow-ups were not undertaken. Third, the sample size was relatively small. Beginning with a sample size of 80 does limit the final sample size given the inevitability of attrition. As is clear to researchers who intend to conduct longitudinal research, one needs to start off with sample sizes of at least one-third larger than the final desired sample size and to develop many personal ties between researcher and participant in order to combat attrition problems.

Given the fact that the study was not intended to be a longitudinal one, what is lacking in quantity of data is somewhat made up for in quality of data. If this were merely a short-term longitudinal study with a sample size ranging from 45 to 70, then

its sample size would clearly be a concern. The extensiveness and richness of the 1950 assessment, however, with 6–10 observers for most every personality variable and with data being collected from objective tests, life-histories, observer-ratings, group and individual activities, are relatively rare in personality assessment. Multiple observations of multiple traits is a tried and true method of decreasing error variance and thereby increasing power (Campbell & Fiske, 1959; Kenny & Kashy, 1992). Sample size is only one component that affects power, with measurement error being another (Cohen, 1988; Howell, 1997), and the current investigation lessened error variance through aggregation and multiple measures of multiple traits.

Psychometric considerations aside, we should also not lose sight of what this data set represents: a 44-year long investigation into the beginning and ending of the careers of 80 talented men. Only a handful of studies in the history of psychology can claim covering a longer period of time in the lives of its participants. It should also be noted that the limitations encountered here are not necessarily unique to the current investigation either, as Campbell and Stanley (1967) and Schaie (1983) have long ago made us aware. Longitudinal studies are necessarily beset with internal and external validity problems such as maturation, history, mortality, and cohort effects to name a few. Longitudinal research is difficult and beset with problems and yet we are all the more convinced that it is the best methodology available to personality psychologists interested in understanding the mechanisms and complexities behind behavior over the life course, in this case behind creative achievement. Our hope is that the current investigation is one small step toward such understanding.

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