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Searching for Tomorrow's Innovators: Profiling Creative Adolescents

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Profiling may be a viable means of identifying those creative adolescents who can benefit from specialized guidance and exploration of science, technology, engineering, and mathematics (STEM) fields, arts, and human services. The experimenters developed 1 general and 5 specific profiles including interest, personality, and achievement variables based on the profiles of eminent people in five domains of creative endeavor. Educators of gifted students at schools throughout a Midwestern state identified 485 students to attend a research through service counseling laboratory. One cohort received the Vocational Preference Inventory, the Personality Research Form, and the Tellegen Absorption Scale, and a second cohort received the VPI, the Revised NEO Personality Inventory (NEO- PI-R), and Tellegen Absorption Scale. For each cohort, descriptive data were gathered and principal components analyses were performed on scales of interest and personality inventories. In addition, a cluster analysis was performed for the second cohort. The finding supported the hypothesis that profiling could be used to identify creative adolescents for career development programs. Both principal components analyses and cluster analyses revealed profiles of fine and performing arts students: one or two profiles of interpersonally talented groupings: and an engineering/technical profile. Creative students were more agreeable than those in previous studies, and there was strong evidence for crossover arts/science profiles.

It is generally acknowledged that creativity and innovation are central to the health of the global economy (Batey & Furnham, 2006). The National Science Foundation (2007) and the National Academy of Science (2010) have called for research on the people and processes that bring about innovation in science, technology, engineering, and mathematics (STEM) fields. The group of innovators necessary to society is not only composed of scientists and engineers. It also includes people in design, education, arts, music, and entertainment who interact in creative communities. If creative people and the innovations they produce are critical to the future, how do counselors find them? How do counselors guide them toward positions in STEM, in the arts, and in entrepreneurship?

Career counseling practices for academically talented students generally have not addressed the needs of creatively gifted students, nor has there been a significant literature of career development for creative individuals (Chopp & Kerr, 2008). Most identification practices for creative students have as their goal the selection of students for a gifted education program. These are focused on cognitive abilities, as measured by instruments such as the Torrance Tests of Creative Thinking (1974) or general creative behaviors, such as the Scales for Rating the Behavioral Characteristics of Superior Students (Renzulli, Smith, White, Callahan & Hartman, 1977), and the Runco Ideational Behavior Scale (Runco, Plucker, & Lim, 2000–2001). Other identification

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practices have as their goal the selection of students for special schools in fine or performing arts, and portfolios and auditions are the primary means of identification of creative talent (Cannatella, 2001). Finally, selection of students for invention programs focus on projects and competitions (Goldberg, 2009). It is difficult, however, for counselors to identify those students with potential for success in creative fields for the specialized career counseling they need, because they often do not have access to cognitive measures, portfolios, or competition results.

In STEM fields, there has been much emphasis on widening the pool of potential scientists by attracting women, minorities, and people who otherwise might not have considered options in science. Few efforts have been made to identify those students who are likely to be creative in STEM fields—a characteristic that cuts across race, class, and gender (Domino & Domino, 2006). It is particularly important for counselors to find and guide those people who are most likely to be scientific innovators into appropriate educational and career paths.

This is partly because of the continuing controversy over the identification of creative students. Individual creativity in a wide variety of studies is predicted by a complex combination of personality factors, cognitive style and abilities, relevant task domain expertise, motivation, and sociological and contextual influences. Early reviews consistently found core personality traits that are reasonably stable across domains (R. Barron & Harrington, 1981; Runco, 1984). These traits include broad interests, independence of judgment, autonomy, and openness to experience. Openness to experience is consistently correlated with measures of creativity. In a meta-analysis that explored personality traits in scientific and artistic creativity, Feist (1998) linked personality findings to the Big Five personality factors: neuroticism, extroversion, openness to experience, agreeability, and conscientiousness. Feist found that across both artistic and scientific domains, creative individuals were characterized by high openness to new experiences, low agreeability (nonconforming) and low conscientiousness. Personality facets of the Big Five Personality Factors, including three facets of openness to experience (aesthetics, actions, and ideas); two of neuroticism (angry hostility and negative vulnerability) and two of conscientiousness (competence and negative deliberation) provided a nuanced profile of the personality of creative individuals in a study by Batey, Chamorro-Premuzik, and Furnham (2010).

Csikzentmihalyi (1996), who took a systems approach to his study of 100 eminently creative individuals, found core characteristics in the creative people he interviewed. He added to the aforementioned list of core characteristics the ability to reconcile opposites and most important, the ability to experience flow consciousness. Flow consciousness, which has been studied in depth mainly in the areas of sports psychology and the performing arts, has been found to be a state of mind claimed by creative, high performers—an optimal state of intrinsic motivation, where the person is fully immersed in what he or she is doing. The creative individual experiences great absorption, engagement, and challenge—and all other needs and sensory input are ignored. Capacity for absorption (Manmiller, Kumar, & Pekala, 2005) may be an important characteristic of creative people that leads to flow consciousness.

A long-running theme in the literature of creativity is the link between creativity and mental illness. Although once creativity, genius, and giftedness were all considered perilous to mental health, findings in the last 3 decades (Andreasen, 2008, Ivcevic & Mayer, 2006; Jamison, 1989) have expanded the understanding of relationship of artistic or expressive creativity and trait mania. Ivcevic and Mayer found trait hypomania as a core characteristic of creativity in their study of core characteristics and specific characteristics. Cognitive scientists have found decreased latent inhibition in creative people, which may be associated with impulsivity (Carson, Peterson, & Higgins, 2003) A study by Furnham, Batey, Anand, and Mansfield (2008) affirmed that hypomania is correlated with divergent thinking, self-rated creativity, and creative behaviors.

Creativity is often assessed without regard to the domain of work. Ivcevic and Mayer (2006) addressed this issue by performing a hierarchical cluster analysis with a group of 40 young adults to determine if there were distinct types of creative domain clusters based on different personality traits, emotions and motivation, cognition, social expression, and self-regulation. Their analysis yielded four profiles of creative traits and behaviors that discriminated between the conventional person, the everyday creative person, the artist, and the scholar. People they labeled as creative were characterized by openness to experience, creative role (such as artist or writer), persistence, trait hypomania (the ability to work with intense energy in a specific area of study for long periods of time), and intellectual curiosity. A scholar cluster of traits also emerged, which included risk-taking, divergent thinking, and intrinsic motivation. Ivsevic and Mayer (2006) suggested that "results related to both specificity and generality point to the need to better understand different kinds of creativity. Since most creativity appears to be rather domain specific, it is useful to assess creativity in specific domains and make conclusions limited to those domains" (p.80).

Because hundreds of studies have confirmed that vocational personality traits tend to cluster into six occupational personality areas (Holland, 1996), it stands to reason that creative people might also have differing

personality traits in different domains. There have been strong arguments against situated cognition (Plucker, 2000), which is the notion that creative cognition might differ within specific domains or disciplines. This resistance to domain-specific assessment is based on frequent findings of a unitary divergent thinking factor underlying creativity tasks in different domains. It is likely, however, that personality characteristics interact with cognitive abilities, subtly modifying the potential course of individuals' trajectory into the world of work. People do not simply gravitate toward creative or noncreative careers; they lean toward a particular career path because it seems to fulfill a complex combination of talents, needs, interests, activity level, and values. By adolescence, these characteristics may have been shaped by education and socialization into specific clusters, or profiles, that can be matched with career development pathways.

Assessments that focus on only one aspect of creativity, such as creative thinking (Torrance, 1984), creative personality (Feist, 1998), or creative people's interactions with the environment (Amabile, 1993) are less likely to predict career development pathways than those that are more holistic and comprehensive. For the purposes of career development, unitary assessments of creativity leave much to be desired. Some are too narrow in focus; some are very difficult to administer and score; and some are very expensive.

An efficient method of identifying young people with potential for creative careers might be a profiling approach. In Kerr, Kurpius, and Harkins' (2005) 10-year study of math/science-talented girls, a profiling technique was developed that incorporated achievement scores and grades with personality profiles that reflected the characteristics of accomplished women scientists. These vocational interests and personalities of the profiled group matched those of the criterion group of scientists. It is possible, therefore, that a profiling method may be very appropriate for the identification of creative young men and women who can profit from specialized career counseling interventions.

PARTICIPANTS

The participants were 485 high school students, from all regions of Kansas, whose average age was 16 years. Most of the participants were European American ($N = 428$, 88.4%), followed by Hispanic ($N = 16$, 3.5%), Asian/Pacific Islander ($N = 12$, 2.5%), Native American ($N = 9$, 1.6%), and African American ($N = 9$, 1.6%) and the rest identified themselves as Other ($N = 15$, 3.4%). Participants reported that they live either in a suburban ($N = 157$, 47.4%), rural ($N = 147$, 44.4%), or urban ($N = 27$, 8.2%) setting. The racial/ethnic proportions and the geographic status reflect the population of this state, where 88% of the population is European-American, and most people live in suburbs or rural areas.

Participants for this study were the first two cohorts (Year 1 and Year 2) to be selected to attend the career counseling program of the Counseling Laboratory for the Exploration of Optimal States (Project CLEOS), a research-through-service laboratory investigating and serving the needs of creative people. Students attended 8–10 weekly groups throughout the school year. They were recruited through letters to 60 coordinators of gifted programs in the state. Coordinators were asked to consult with lead guidance counselors and other departmental coordinators to match profiles with particular students. The following core-characteristics profile was given to coordinators:

> Creatively gifted students may be spontaneous, expressive, intuitive, and perceptive, with evidence of intellectual sophistication and childlike playfulness. They are very likely to be curious, open to new experiences, and innovative in many areas of their lives. They may express originality in thoughts, and are probably unafraid of what others might think of their ideas. Most likely, these students have a wide range of interests and abilities, and may be comfortable with ambiguity and disorder. Likely to be unconventional, creatively gifted students are imaginative, and may challenge the status quo. By late adolescence, truly creative individuals usually have significant creative accomplishments that have earned them recognition by experts in their domain. (Sources: Amabile, 1983; Csikzentmihalyi, 1996; Goertzel, Goertzel, Goertzel, & Hansen, 2004; Runco 1984; Simonton, 1984b; Torrance, 1984)

To develop individual domain profiles, a literature review of biographical and psychological analyses of creatively eminent people in general was first performed, and then studies of creative people in specific domains were gathered. Works were then categorized as (a) investigations using objective assessments, standardized protocols, and empirical methodology; (b) studies based on biographical data and/or clinical interviews, with explicit selection criteria; (c) literature reviews in peer reviewed journals and scholarly publications; and (d) case studies or small sample qualitative studies. A and B literature formed the primary sources for both general descriptors and specific domain profiles. Statements for the general descriptors were taken from summary, definitive, and synthetic sections of works on eminently creative people in general. Literature pertaining to individuals in specific domains was then grouped according to talent domains that were commonly used in the literature of eminence and creativity: verbal/linguistic; mathematical/scientific; spatial/visual, interpersonal/

emotional; and musical/dance. Whenever possible, profiles were written from these materials based on information about what creative adults in these specific domains were like as adolescents. That is, in addition to cognitive and personality characteristics, biographical elements common to individuals in particular domains were used to round out profiles of creative adolescents.

Profiles, and the sources of the descriptors, are as follows:

> Language; Verbal/linguistic creativity; potential writers, journalists, translators, and linguists. The student is likely to be a precocious and avid reader with an extensive knowledge of literature; a sophisticated writer; may have advanced ability to learn other languages. The student should have outstanding verbal accomplishments. He/she may be witty and expressive. Verbal precocity may get him or her in trouble. The student is likely to have excellent grades in Language Arts/English/Foreign language when interested, and have high scores on verbal achievement tests. May have mood swings, ranging from expansive, energetic, optimism when he or she works day and night with intensity on a project, to periods of self-doubt, low energy, and cynicism. (Sources: Andreason, 1987; F. Barron, 1969; Jamison, 1989; Kaufman, 2001, 2002; Piirto, 2002; Valdés, 2003; VanTassel-Baska, Johnson, & Boyce, 1996).

Mathematical and Scientific Inventiveness

> The student may be a natural mathematician with an ability to perform complex computations in his or her head or who possesses an advanced understanding of mathematical and scientific concepts. The student loves science, experimentation, and new technology. In addition, the student enjoys manipulating materials and information, tinkering, adjusting the designs of objects, apparel, hardware and software. Intense curiosity and fascination with enigmas and unsolved problems leads this student to read widely and in depth. If challenged, the student has good grades in math, science, and laboratory classes; if not, the student may expend little effort. Most scientists and inventors as adolescents had significant accomplishments such as winning regional or national math and science competitions, or having patentable inventions or designs that were income-producing. These students are usually well-adjusted, but are likely to have just a few like-minded friends. (Sources: Assouline & Lupkowski-Shoplik, 2005; Benbow & Lubinski, 2006; Colangelo, Assouline, Croft, & Ihrig, 2003; Feist, 2006; Simonton, 1988; Sriraman, 2005; Subotnik, Maurer, & Steiner, 2001).

Interpersonal/Emotional Creativity

> These students are characterized by emotional intelligence, meaning they have the ability to understand and manage their own emotions and those of others. The student may be a natural mimic, able to do impressions, absorb accents, and "get inside another's skin." The student may be the kind of helper that other students seek out for help and or a natural leader who is usually selected by peers to lead in both formal and informal situations. They are extraverted and people-oriented, able to form relationships across cultures and age groups; agreeable and friendly toward all. They thrive on connection, and experience deep empathy. They may have excellent grades in social sciences, debate, rhetoric, and leadership courses, as well as recognition for performance, leadership, or volunteerism. (Sources: Bolton & Thompson, 2004; Daloz, Keen, Keen, & Parks, 1996; Hogan, Curphy, & Hogan, 1994; Montuori & Purser, 1999; Salovey & Grewel, 2005; Simonton, 1984a.

Musical and Dance Creativity

> The student has the ability to sing or play instruments—usually multiple instruments—or to dance with technical expertise and imagination. She or he may have an intuitive understanding of music or movement, and often has perfect pitch, excellent rhythm, and musical memory. The student can compose or choreograph; his or her own creations have won the recognition of experts. The student dances, sings, and performs as often as possible—but may be defensive, anxious, or perfectionistic, sometimes leading to denial of coveted roles while in school. These students possess excellent musical knowledge in one or more genres, such as hip hop, jazz, pop, or classical, and may have sought out rare and little known pieces for inspiration. Although more introverted than extraverted, the student is likely to be transformed on stage into an expressive, creative performer, entering a flow state that conquers shyness or anxiety. (Sources: Kogan, 2002; Oreck, Owen, & Baum, 2003; Slaboda, 1988, 2005; Van Rossum, 2001).

Spatial Visual Creativity

> The student has a powerful ability to visualize designs, colors, and to manipulate 3D images in mind and an ability to draw models and designs with technical skill. The student is imaginative and original in thinking, conversation, and attire. He or she creates cartoons, Web sites, paintings, graphic art, sculpture, photography, video, or architecture that has already earned the recognition of experts. The student may have excellent grades in art, photography, shop, drawing, or other course emphasizing spatial/visual ability, but may underperform in other classes. Like writers, artists are likely to have mood swings, but those students who lean more toward design and architecture may be more stable in mood. The student is more introverted than extroverted, reflective, and easily enters flow states. (Sources: F. Barron, 1972; Csikszentmihalyi & Getzels, 1971;

Dudek & Hall, 1991; Kay, 2000; MacKinnon, 1961; Pariser & Zimmerman, 2004; Stohs, 1992)

The gifted coordinator sought permission from parents to be contacted by the researchers. Materials for the study were sent to parents, and their consent was returned to the researchers before their child's participation. The student's assent was sought on the day of the workshop.

MEASURES

All students took The Vocational Preference Inventory (VPI; Holland, 1996). The VPI is a 160-item measure appropriate for individuals from 14 to 75 years old. The VPI is one of the most widely used vocational interest tests with adolescents and young adults and consists entirely of occupational titles; patterns of responding to these titles yield three letter codes representing the individual's vocational personality. The respondent can reply *yes* (interesting, appealing), *no* (uninteresting, dislikes), or *no response* (undecided). Factor analyses of the VPI have consistently yielded six clusters of vocational personalities, including realistic, investigative, artistic, social, enterprising, and conventional, and the predictive, construct, and concurrent validity and all forms of reliability are well established. Additionally, the VPI was found to be correlated to assessments with similar scales, such as the Strong Vocational Interest Bank (Gaffey & Walsh, 1974). The VPI contains 11 scales—realistic, investigative, artistic, social, enterprising, conventional, self-control, masculinity, status, infrequency, and acquiescence. For the purpose of this study, only the scales pertinent to the Holland code—realistic, investigative, artistic, social, enterprising, and conventional—were assessed.

The Tellegen Absorption Scale (TAS; Tellegen & Atkinson, 1974) is a 34-item scale and was designed as a measure of openness to absorbing and self-altering experiences. As such, it may be a measure of an individual's capacity to enter flow consciousness states. The original measure was devised as a dichotomous true or false format. The form used this study was the four-point Likert Scale form, with total scores ranging from 0 to 100. The items on the TAS are split into both factor structures (responsiveness to engaging stimuli, synesthesia, enhanced cognition, oblivious dissociative involvement, vivid reminiscence, and enhanced awareness) and content analysis (is responsive to engaging stimuli, is responsive to "inductive" stimuli, often thinks in images, can summon vivid and suggestive images, has "crossmodal" experiences, can become absorbed in own thoughts and imaginings, can vividly reexperience the past, has episodes of expanded awareness, and experiences altered states of consciousness). Tellegen (1982) reported an internal reliability of $r = .88$ and a 30-day test–retest reliability of $r = .91$. Total TAS scores were used for this study.

The first cohort of students received the Personality Research Form (PRF; Jackson, 1994), a 352-item assessment provides 22 subscales such as achievement, affiliation, aggression, autonomy, dominance; nurturance, exhibition, cognitive structure, play, with subscale reliabilities ranging from moderate to very high. Scales are based on Henry Murray's original need scales and have been extensively used in personality research. It has high concurrent and predictive validity, correlating highly with similar personality inventories. The median reliability coefficients are in the high (.80) range.

A second cohort of students was given the NEO PI-R (Costa & McCrae, 1992), rather than the PRF. The NEO PI-R is a well-established measure that yields five dimensions of personality, and is appropriate for older adolescents (Soto, John, Gosling, & Potter, 2008). This 240-item assessment has coefficient alphas of .92 (neuroticism), .89 (extraversion), .87 (openness), .86 (agreeableness), and .90 (conscientiousness). Numerous studies have supported the construct validity and reliability of the instrument.

The procedures used for this study are based on techniques developed for counseling talented adolescents for scientific careers (Kerr, Kurpius, & Harkins, 2005). Participants completed an 8-hr career development workshop, in which these assessments were administered for 2 hr in groups in the morning, and individually interpreted by counselors in the afternoon.

RESULTS

Cohort 1

Abilities The participants had an average GPA of 3.73 ($SD = 0.44$). Only 61% had been selected for gifted programs. Only a small number of students had taken the ACT or SAT, and schools used a wide variety of achievement tests at different times; therefore, standardized achievement test scores were not comparable or available. The participants in the modal group were in the upper 5% of their classes, with GPAs qualifying them for very selective institutions. It should also be noted, however, that the standard deviation indicated wide variability of GPAs, which ranged from .85 to 4.0.

Interests. The means and standard deviations for interest scale scores are presented in Table 1. The order of the means, from highest to lowest, was artistic, investigative, social, enterprising, realistic, and conventional.

TABLE 1
Descriptive Statistics for Cohort 1 ($N = 309$)

Variable	*Mean*	*SD*
GPA*	3.73	0.44
VPI Realistic	3.15	3.25
VPI Investigative	5.51	4.07
VPI Artistic	6.55	4.34
VPI Social	3.99	3.29
VPI Enterprising	3.13	3.21
VPI Conventional	1.41	2.23
PRF Abasement	7.07	2.70
PRF Achievement	9.83	3.59
PRF Affiliation	10.33	3.61
PRF Aggression	8.20	3.52
PRF Autonomy	8.08	3.77
PRF Change	9.02	3.24
PRF Cognitive Structure	7.12	3.36
PRF Defendence	7.13	3.64
PRF Dominance	9.47	4.03
PRF Endurance	10.16	3.52
PRF Exhibition	9.01	4.38
PRF Harmavoidance	6.83	4.25
PRF Impulsiveness	8.28	4.13
PRF Nurturance	10.03	3.34
PRF Order	4.92	3.99
PRF Play	11.19	3.22
PRF Sentience	10.06	2.96
PRF Social Recognition.	8.45	3.62
PRF Succorance	7.06	3.85
PRF Understanding	9.42	3.57
Total Tellegen	59.28	20.60

Note. GPA = Grade point average. VPI = Vocational preference inventory. PRF = Personality research form.
*$n = 255$.

TABLE 2
Factor Loadings for Principal Component Analysis with Varimax Rotation of Interest, Personality, and Absorption Scales

Rotated Component	*1*	*2*	*3*	*4*	*5*
VPI Realistic	.136	−.096	−.239	−.302	.486
VPI Investigative	.494	−.254	.227	−.182	.453
VPI Artistic	.720	.070	−.048	−.013	.217
VPI Social	.291	.213	.001	.495	.489
VPI Enterprising	−.006	.407	−.009	.146	.719
VPI Conventional	−.192	−.098	.096	.017	.719
Total Tellegen Score	.732	.038	−.095	.084	−.119
PRF Achievement	.064	.088	.835	.090	−.083
PRF Affiliation	.008	.647	−.091	.468	−.088
PRF Aggression	−.108	.521	−.088	−.545	.032
PRF Autonomy	.274	−.060	−.187	−.739	−.042
PRF Cognitive Structure	−.243	−.008	.603	.193	.157
PRF Endurance	.125	−.029	.780	.070	−.027
PRF Nurturance	.281	.044	.123	.756	−.053
PRF Sentience	.690	.110	−.041	.126	−.104
PRF Understanding	.623	−.085	.394	−.071	−.013
PRF Dominance	−.035	.705	.364	−.153	.153
PRF Exhibition	.189	.834	−.061	.087	−.021

Note. VPI = Vocational preference inventory. PRF = Personality research form. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
[a]Rotation converged in 7 iterations.

The modal Holland two-letter codes were AI, followed by IA and IS.

Artistic personalities are described as *complicated, original, impulsive, independent, expressive, and creative*; people who score high on artistic interests are found in art, music, dance, and writing careers. Investigative personalities are described as *analytical, intellectual, reserved, independent*, and *scholarly*; people who score high on Investigative interests are found in scientific and academic careers (Holland, 1997).

The participants' highest needs on the Personality Research Form were play, affiliation, endurance, sentience, and nurturance. Their lowest needs were order, harm avoidance, defendence, and cognitive structure. The TAS mean, at 59.28, reflected very high capacity for absorption (compared to a mean of 38 for normal college student samples).

Principal Components Analyses with varimax rotations were performed to reduce the data and to determine if there were themes underlying the participants' responses to the subscales of the VPI and the PRF and the total score on the TAS. The components that emerged were as follows: Factor 1 was characterized by artistic and investigative interests; by needs for sentience and understanding; and high capacity for absorption. Factor 2 was characterized by enterprising interests, needs for exhibition, dominance, affiliation, and aggression. Factor 3 was achievement, endurance, and cognitive structure. factor 4 was characterized by high social interests, high nurturance and affiliation and low dominance and low aggression. Finally, Factor 5 was difficult to interpret, with high interests in all vocational types except artistic, and no needs (measured by PRF scores) attaining high loadings. Results of the Principal Component Analysis are shown in Table 2.

Cohort 2

Abilities The mean GPA for Cohort 2 was 3.70 ($SD = 0.50$). The GPA for this second cohort was not significantly different from that of Cohort 1, indicating that, again, this was a group with generally high academic achievement, but with a variable range. Only 62% had qualified for the school's gifted education program.

Interests. The second cohort of students' patterns of vocational interests were in the same order of strength as the first cohort: artistic, investigative, social, realistic, enterprising, and conventional. The modal combination was AI, followed by IA, AS, and IS.

TABLE 3
Component Transformation Matrix (Cohort 1)

Component	*1*	*2*	*3*	*4*	*5*
1	.600	.408	.421	.490	.237
2	.777	−.319	−.332	−.426	.056
3	−.053	.748	−.596	−.162	.239
4	−.168	−.062	.377	−.450	.790
5	.080	.410	.464	−.592	−.510

Note. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Personality. On the NEO-PI, the order of the means was: openness to experience, extraversion, agreeableness, conscientiousness, and neuroticism. People with openness to experience are characterized by inventiveness and curiosity as well as an appreciation for art, emotion, adventure, unusual ideas, curiosity, and variety of experience (Costa & McCrae, 1992). People high on extraversion are outgoing and energetic, and are described as having positive emotions, urgency, and the tendency to seek stimulation in the company of others. The lowest mean of the group, neuroticism, implies that these people are secure and confident, and not prone to depression or anxiety.

A principal components analysis with varimax rotation was performed on subscales of the VPI and NEO as well as the total TAS scores. The factor structure that emerged was as follows: Factor 1 included artistic and investigative interests, openness to experience and capacity for absorption. Factor 2 included enterprising and social interests and extraversion. Factor 3 included realistic, investigative, and conventional interests and low extraversion (introversion). Factor 4 was characterized by low neuroticism and high agreeableness and conscientiousness.

TABLE 4
Descriptive Statistics for Cohort 2

	Mean	*SD*	*N*
GPA	3.70	0.50	140
VPI Realistic	3.06	3.23	176
VPI Investigative	6.10	4.06	176
VPI Artistic	6.73	4.47	176
VPI Social	4.22	3.23	176
VPI Enterprising	2.99	3.15	176
VPI Conventional	1.40	2.22	176
NEO Neuroticism	92.89	21.24	168
NEO Extraversion	119.57	18.86	168
NEO Openness	128.73	21.36	168
NEO Agreeableness	110.82	22.65	168
NEO Conscient.	101.58	22.95	168
Total Tellegen	58.73	21.33	176

Note. GPA = Grade point average. VPI = Vocational preference inventory. PRF = Personality research form.

TABLE 5
Factor Loadings for Principal Component Analysis with Varimax Rotation of Interest, Personality, and Absorption Scales

	Component			
	1	*2*	*3*	*4*
VPI Realistic	.031	−.071	.795	.006
VPI Investigative	.430	.019	.573	.250
VPI Artistic	.742	.199	.082	.035
VPI Social	.245	.670	.024	.152
VPI Enterprising	.043	.828	.167	−.108
VPI Conventional	−.261	.422	.537	−.240
NEO Neuroticism	.264	.054	−.097	−.664
NEO Extraversion	.036	.650	−.348	.210
NEO Openness	.856	.082	−.021	.064
NEO Agreeableness	.235	.120	−.028	.653
NEO Conscientiousness	−.478	.235	−.169	.453
Total Tellegen Score	.796	.058	−.012	−.146

Note. VPI = Vocational preference inventory. PRF = Personality research form. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

[a]Rotation converged in 8 iterations.

TABLE 6
Component Transformation Matrix

Component	*1*	*2*	*3*	*4*
1	.924	.342	.172	−.004
2	−.302	.868	−.094	.383
3	−.227	.153	.913	−.301
4	.058	−.326	.357	.873

Note. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

A hierarchical cluster analysis using the Ward method was performed to produce clusters of cases with high homogeneity within clusters and heterogeneity between clusters of cases. A range of three to five solutions was stipulated. A four-cluster solution yielded patterns that were easiest to interpret. The first cluster to emerge included participants who were artistic and investigative in interests, open to experience, nonconscientious. The second cluster was social, enterprising, and artistic in interests and extraverted. The third cluster was conventional and social in interests, conscientious, high on agreeability, and low on openness to experience. The fourth cluster was high on realistic interests and low on all others, and characterized by high conscientiousness.

DISCUSSION

Can profiling identify creative adolescents who need specialized career development strategies? The results of

this study seem to support profiling as a viable strategy for locating those students most in need of specialized guidance for creative careers. First, an examination of the means for academic achievement, vocational interests, personality characteristics, and capacity for flow shows that, in the case of both cohorts, teachers selected students who match the core characteristics of creatively gifted adults. The GPA for these students places them as well above average in achievement, despite a considerable range. A variety of studies have shown that creatively gifted individuals tend to be motivated to achieve in those courses in which they are most interested, and to give moderate effort, or purposely underachieve in those courses that hold little interest for them (Colangelo & Kerr, 1993; Colangelo, Kerr, Huesman, Hallowell, & Gaeth, 1992; Csiksentmihaly, 1996). Almost a third of the group had not qualified for gifted programming at their schools, indicating that a large number of creative students are not being served by specialized educational programs. This, too, is probably in keeping with the tendency of creative individuals to specialize early, to be less well-rounded, and occasionally to lack the motivation and interpersonal characteristics that would make them attractive to those who select students for gifted programs (Csiksentmihaly, 1996).

The patterns of vocational interests of the two groups are similar and are precisely those that would be those expected for people interested in creative occupations. The combinations of artistic—investigative predominate: Artistic people are described as expressive, original, imaginative, spontaneous, and nonconforming; investigative people are described as analytical, scientific, intellectual, curious, and data-oriented (Holland, 1997). Creative scholars in all fields; interdisciplinary professionals who combine artistic and scientific skills; and imaginative intellectuals in media and public life are all likely to have this vocational combination. The high means for social interests adds a strong element to this mix of a concern for people, an enjoyment of social activities, and interpersonal skills. Although the high means for social interests are not characteristic of people in the fine arts, physical sciences, and mathematically oriented careers (Holland, 1997), it is apparent from these vocational interest scores (and personality characteristics described in the following), that there were many socially oriented young people in the two cohorts. In addition, there were many combinations of artistic–social (such as those interested in performing arts and communications) and investigative–social (such as those interested in health professions and science teaching).

The means for personality characteristics of both cohorts were also very like those of creative people. The extreme play scores of the first group are in keeping with the frequent observations in the literature of the playfulness of creative people (F. Barron, 1972; Colangelo et al., 1992; Feist, 1998; Torrance, 1984). The very high scores for endurance not only are characteristic of adult innovators, long observed to be extremely persistent and task-committed in their chosen field (Csiksentmihalyi, 1996) but also present an interesting contrast to the characteristic of play. That these young people combine playfulness and endurance is evidence of the kind of polarities found in creative individuals (Csikszentmihalyi, 1996). Finally, the high mean for openness to experience in the second cohort indicated that these young people possessed the personality characteristic that has become the signature characteristic of creative people (Batey et al., 2010; Costa & McCrae, 1992).

In both cohorts, personality characteristics associated with hypomania were common, not only in terms of playfulness, but high energy and gregariousness; on the other hand, neurotic traits associated with depression were rare in both cohorts. Artists, writers, and musicians have been found to suffer much higher rates of bipolar disorder and to score higher on measures of neuroticism and psychoticism. (Andreason, 1987; Jamison, 1989; Kaufman, 2001). The kind of high energy displayed by these students, however, appeared to be a healthy vigor and enthusiasm rather than a more dysfunctional bipolar spectrum characteristic.

Another exception to the description in the literature of creative personality was the observation of high means for affiliation and nurturance in the first cohort, as well as the high scores for agreeableness and low scores for neuroticism in the second cohort. These groups of adolescents appear to be more friendly, socially oriented, and socially well-adjusted than descriptions of most creatively gifted adults found in personality studies (Batey et al., 2010). Eminent scientists and mathematicians are more likely to be introverted, uninterested in social activities, and moderately low in agreeability (Feist, 1998; Helson & Pals, 2000; Holland, 1997).

What accounts for the agreeableness and good adjustment of these groups of adolescents? First, it is possible that teachers selected students who were more agreeable, or that less well-adjusted students chose not to participate in the project. It is important, nevertheless, to consider that these cohorts of creative adolescents may be different both from their predecessors, as well as from those in other cultural settings. They are part of the generation that has been labeled the *We Generation*—more connected with each other, more community oriented, more affiliative than generations that went before (Greenberg & Weber, 2008). It may be that this is the first generation of creative young people to have found one another online, to have been able to find friends with similar interests, and to have been inspired to a more social outlook and lifestyle than the artists

and scientists of previous generations who worked in isolation.

Both the factor structure and cluster analysis did not support the domains originally constructed for profiles, but tended to group verbal, artistic, scientific-analytical, and musical together; to provide strong support for one or two interpersonally-oriented groups; and to group realistic-practical introverts together. In the principal components analyses, the varimax rotation produced independent factors underlying the collection of subscales; a previous oblique rotation had uncovered similar, but more overlapping factors. The core characteristics identified by many researchers as those of creative individuals emerged as one factor, with the other factors seeming to represent the characteristics of social leaders and helpers, of high achievers, and practical/technical people. The Ward method used in the cluster analysis also created fairly independent clusters that yielded individuals with creative interests and characteristics; leaders; helpers; and conscientious, practical people. Plucker (2000) made the case against discipline or domain specific creativity, arguing that most of the research supporting domain specific creativity was flawed. Instead, he argued for the importance of a general creativity factor in abilities. It may be that in personality characteristics as well, that a general factor exists, representing what Feist (1998) called core characteristics of creative personality.

On the other hand, one must consider the possibility that the clustering together of personality characteristics, vocational characteristics, and absorption to form a general creative profile could be artifactual—that is, related to the content of the instruments. There is a strong bias in both the PRF and NEO–PI scales associated with creativity toward aesthetic and intellectual creativity. In addition, the TAS is biased toward aesthetic and visual absorption, with little attention to absorption as experienced in mathematical or scientific activity or in interpersonal activity. Instead, it may be that the instruments do not tap the characteristics, needs, and motivations of technically inventive individuals, as Colangelo et al. (1992) suggested. Nor do these instruments tap the characteristics, needs, and motivations of interpersonally creative individuals. It may be that the other components and clusters to emerge—the technically oriented and the socially oriented, represent creative students whose primary personality characteristics are in one group, practicality and in a second group, agreeability.

Implications for Research

If interpersonal creativity is marked by empathy, then adding measures of emotional intelligence (Bar-On, 2007) in research such as this might clarify the profiles of adolescents who have potential to be creative leaders and counselors. If scientific creativity is marked by intense curiosity, then measures of curiosity and exploration (Litman, 2008) might be a useful addition to profiles of potential technical innovators in STEM fields.

In this study, adolescents profiled as creative had high scores on absorption. Absorption, as measured by the TAS (Tellegen & Atkinson, 1974) may be related to one's capacity to experience flow. Future studies should investigate whether the flow experienced by fine artists, performing artists, creative leaders and helpers, scientists, and engineers differs in intensity or quality of absorption. A study linking the characteristics of absorption and creativity has been performed by Manmiller, Kumar, and Pekala (2005) may provide a basis for such work.

To further refine the profiles, the next step is to use the more sophisticated statistical strategy of latent profile analysis on the next cohort to develop clear clusters of cases that fit particular profiles. A natural extension of this research is validate the profiles through administration of other major instruments used in identification of creative students such as the Torrance Tests of Creative Thinking and the Runco Ideational Behavior Scale to understand the relationship of cognitive variables to these clusters of personality, interest, and absorption variables. Follow-up studies using standardized measures of creative accomplishment are needed to establish long-term predictive validity.

Implications for Practice

To find the innovators, those who have the potential to make creative contributions to the global economy, research suggests that it is necessary to look beyond the traditional pool of math/science talent (i.e., those adolescents with high scores in math and science scores). The group of potential STEM candidates that has been overlooked are those who possess exceptional spatial/visual ability (Wai, Lubinski, & Benbow, 2009), but who may not perform as well on assessments of math and science ability. Spatial ability, the "ability to generate, retain, retrieve and transform well-structured visual images" (Lohman, 1994, p. 255), has been identified as a key psychological trait among adolescents that go on to excel in STEM fields (i.e., receive advanced degrees and pursue occupations in STEM fields; Wai et al., 2009). Yet, spatial ability typically is not assessed on aptitude tests, which instead focus on math/science talent. Spatial ability is more commonly considered to be the ability of artists and designers.

Consequently, young people who possess excellent spatial abilities, but who are not as exceptional in math and science may be overlooked in STEM talent searches. Wai and his colleagues (2009) recommended that, to expand the pool of future STEM innovators, spatial

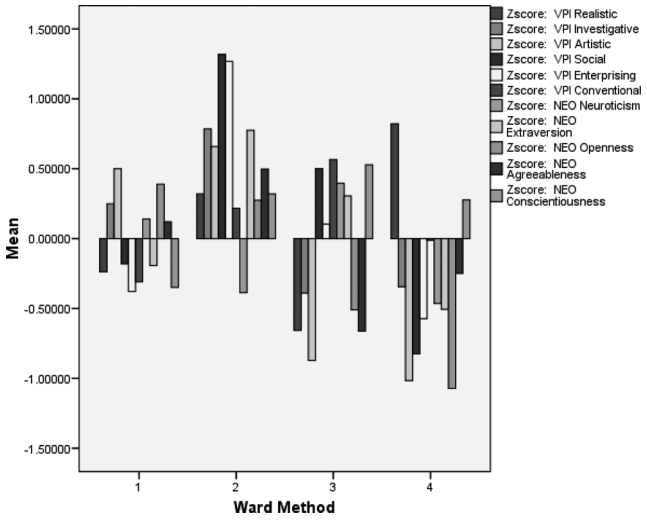

FIGURE 1 Hierachical cluster analysis of VPI And NEO-PI-R scales.

ability should be included in talent searches. The high numbers of the participants with interests in the arts may indicate the presence of spatial talent as well.

Students with combinations of artistic and investigative personalities may be equally capable and creative in STEM careers as well as careers in arts, education, government, and business. Many of these students had crossover profiles, being equally interested in arts and sciences. Creative female adolescents, who are more likely to be attracted to nontraditional career choices because of their tendency to be open to new experiences and more androgynous than average women (Kerr et al., 2005) are prime STEM candidates.

By adding specialized interventions to career exploration classes at both secondary and university level, undecided students will gain additional knowledge and information about paths to creative careers. Students who possess artistic-investigative interests may be encouraged to consider industrial design, robotics, engineering, and applied sciences where their interdisciplinary talents can be maximized.

Although this discussion has focused on the importance of identifying creativity in STEM fields, it is important to emphasize that innovation occurs in the context of creative communities. According to the *Rise of the Creative Class* (Florida, 2002), it is visionary leaders, artists, writers, and musicians who begin the process of founding neighborhoods, academic communities, and finally, entire regions of prosperity. The artists, writers, and musicians create the environments to which other innovators are attracted. These creative artists and performers need help understanding the invisible career ladders in the arts that career development provides.

The profiles that emerged from the study included highly social clusters, with some socially-oriented students more extraverted and others more agreeable. Is it possible that these are the community-makers—the creative young people who found social movements and organizations, who build cohesion among creative people, and harness their energy? They may be those who combine emotional intelligence and creativity (Bar-On, 2007). Profiling methods help to find these students, too, and to validate that their gifts are important to society.

Studies of creatively eminent people have shown the importance of creative young people finding the right fit between their talents and interests and the world of work (Albert, 1992). Focusing on the career development of creative young people may be critical to innovation and renewal in society. Identifying those students who need specialized guidance into creative occupations is the first step toward establishing an innovative society.

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