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The personality and cognitive correlates of creative achievement

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Abstract

The personality traits and creative achievement of 96 individuals were assessed using self-report questionnaires. Creative potential was assessed with Divergent Thinking tests and a short version of the Remote Associates Test. Four factors of personality were extracted with Principal Component Analysis. One factor ("Ideational Fluency") emerged from the 6 divergent thinking tests. Relationships between personality factors and scores on the Creative Achievement Questionnaire (CAQ), with its subsections CAQ Science and CAQ Art, "Ideational Fluency", Insight Problems were explored with multiple regression, showing personality differences associated with artistic and scientific creativity. The relationship between creative potential and creative achievement was explored, showing cognitive differences between artistic and scientific achievers. A brief discussion of the relationship between sex and scientific achievement is presented. It is suggested that cognitive traits, rather than personality, mediate this relationship. Finally, it is argued that similar cognitive traits account for creative production at all levels of achievement.

Keywords: creativity, divergent thinking, creative achievement, personality

1 Introduction

The product approach studies creativity from the point of view of creative production or achievement (the lifetime sum of a person's creative products).

The person approach is concerned with the personality and cognitive features of creative individuals. In contemporary research, this approach relies mainly on psychometric testing and seeks correlations between cognitive and personality attributes related to creativity. Divergent thinking tests are the most commonly used to assess creative potential and a variety of psychological traits have been correlated to performance on these tests.

This study adopts both approaches to investigate the relationship between creative personality and creative achievement.

There is some evidence that schizotypal triats and temperament are associated with creativity. Schizotypal traits as measured by the O-LIFE questionnaire were related to creative thinking styles and a subscale (but not the other three scales) ImpNon (Impulsive Nonconformity) was positively correlated to Divergent Thinking tasks in a sample of British students (Claridge & Blakey, 2009). The same study revealed an even stronger association between creative thinking styles and divergent thinking with the Hyperthermic and the Cyclothymic temperaments of the TEMPS-A scale. The correlation between ImpNon and divergent thinking was replicated in another study and interpreted as the result of a lack of inhibition (of sometimes inappropriate responses) associated with impulsivity, in accord with Eysenck (1995)'s reduced cognitive inhibition theory of creativity (Claridge & McDonald, 2009).

David Nettle found higher level of schizotypal traits (Unusual Experiences, Impulsive NonConformity and Cognitive Disorganization among poets and visual artists. On the other hand, Introvertive Anhedonia (one of the four schizotypal traits) seems to have a negative effect on creative production (Nettle & Clegg, 2005).

Many studies have unequivocably shown that Openness to Experience is linked to creativity. Batey et al. (2010) showed that individual differences in personality traits as measured by the Five Factor Model of personality Costa & McCrae (1992) predict creativity more so than intelligence. Openness to experi-

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ence was the best predictor followed by Conscientiousness (negatively). A finer analysis revealed that some facets of personality accounted for more variation (35 %) in Ideational Behavior than intelligence, gender and personality factors together. These factors were angry hostility, vulnerability (negatively), aesthetics, ideas and deliberation (negatively). This study also revealed the importance of using facets rather than broad personality factors which subsume different facets which may predict an outcome in opposite fashions.

It has even been argued that two bigger factors, Plasticity and Stability, (subsuming the Big Five) jointly predict some creative outcomes (Silvia et al., 2009). This study again revealed that Openness was the best predictor of creativity, being positively related to all but one (math and science) creativity measures.

Feist (1998)'s metanalysis probably provided the most comprehensive overview of the personality traits associated with creative achievement in science and in the arts.

Feist (1998) compared the personality traits of three large sets of samples: scientists versus nonscientists, artists versus non-artists and more creative versus less creative scientists. Thus, a picture of the creative personality emerged, albeit showing differences between the artistic and the scientific personality.

Creative people in general, were more open to experience, less conscientious, more hostile and impulsive. However, artists were less emotionally stable, more unconventional and rule doubting than scientists. On the other hand, less creative scientists were more conscientious, conventional and close-minded than their more creative peers. He also showed that, although scientists were more extraverted than nonscientists, this effect was related to the dominance facet of extraversion and not to the sociability facet (Feist, 1998).

Martin Reuter's pilot study of possible candidate genes for creativity identified a personality trait (SEEK) with a strong biological basis that shares considerable variance with performance on divergent thinking tests (Reuter et al., 2006). The SEEK dimension describes the propensity to engage in exoploratory behaviour and solve novel problems.

Anecdotal accounts exist of the association between unconventionality and creativity or between risk taking and creativity. To the best of my knowledge, this study is the first to investigate this association using a psychometric correlational approach.

Eysenck's theory of Creativity and Psychoticism has received mixed empirical support.

The main contention against this theory is that Psychoticism is too narrow a dimension to account for such a wide range of phenomena as those subsumed by the concept of creativity.

Eysenck's failure to consider Openness to Experience might be due to his 3 dimensions model of personality, which included P, E and N but not Openness to Experience and Conscientiousness.

One common neuropsychological feature underlying Psychoticism and Openness to Experience might be Latent Inhibition (LI). Peterson & Carson (2000) found a negative relationship of LI with Openness and Psychoticism. Carson et al. (2003) showed that reduced LI predicts creative achievement among highly intelligent individuals.

The aim of this study is to use the CAQ to correlate the cognitive and personality profiles with scientific and artistic achievement in a sample from the normal population, without specifically focusing on high achieving subsamples. The cognitive and personality profiles thus found, can be compared with those obtained by studies which addressed more selected samples. This is a preliminary test of the hypothesis that the same personality and cognitive traits are associated with creativity at all levels.

2 Materials and Methods

There were 96 participants of which 36 were male and 59 were female. Age ranged from 19 to 75; with a mean of 25.97 (S.D.= 9.4 years). Of all participants, 70 were students from two Italian universities (Università di Udine and Università VitaSalute San Raffaele). The remaining participants were recruited through ads posted on Facebook. Italian was the first language for all of them. The first 5 tests were administered in the paper version. After finding a suitable online platform (`http://www.keysurvey.co.uk`) the subsequent 91 were administered using the web platform. The questionnaire was not timed so as to avoid time pressure, which could be detrimental to creativity. The study was approved by the Durham University ethics committee.

2.1 Personality

Personality traits were assessed through the following questionnaires:

1. Big Five: A 60-item Italian adaptation (Flebus, 2006) of the IPIP version of the Big Five Questionnaire (International Personality Item Pool, Goldberg, 2001) was used to assess the major personality traits.

2. Unconventionality and Risk Taking: An Italian translation done by the author of the Unconventionality scale of the 10 items IPIP version of Lee and Ashton's Hexaco Personality Inventory (International Personality Item Pool). Risk taking was assessed with an Italian translation done by the author of the 10 items scale of the IPIP version of the Jackson Personality Inventory (JPIR).

3. Temperament: The Italian version of the validated short TEMPS-A (39 items) was used to assess 5 different dimensions: ciclotimia (cyclothima), depressione (depression), irritabilità (irritability), ipertimia (hypomania), ansia (anxiety) (Preti et al., 2010).

4. Creative Personality Scale: Gough's adjective Check List (Gough, 1998) is a well validated and widely used self assessment for creativity on personality characteristics in which the test taker is required to check off characteristic that apply to him/herself.

5. Schizotypy: The OxfordLiverpool Inventory of Feelings and Experiences (OLIFE) is a four-scale questionnaire for measuring schizotypal traits in healthy individuals (Mason & Claridge, 2006). It consists of 4 different scales which tap into separable and well-identified components (Mason & Claridge, 2006). The Impulsive nonconformity and the Introvertive anhedonia scales were used based on findings from previous research of their correlation with creativity (Nettle & Clegg, 2005).

6. Seek: The SEEK dimension of the Affective Neuroscience Personality Scales (ANPS; (Davis et al., 2003)) assesses interest in solving problems and exploratory behaviour. This scale was chosen because in a previous study it turned out to account for a substantial proportion of the variance in creativity in both men and women (Reuter et al., 2006).

Violent behavior was assessed via Rushton (1996)'s self-report inventory of aggressive and violent behavior.

2.2 *Creativity*

An important component of creativity is thought to be "Divergent Thinking".

In order to assess divergent thinking, four verbal tests of the Torrance Test of Creative Thinking (2 alternate uses, one consequences and one questions tasks) (Torrance, 1968) and two verbal subtests of the Inventiveness scale of the BIS (Berliner Intelligenzstruktur-Test) (Jäger et al., 1997) were used. The tests were not timed and were scored for number of answers (fluency).

Two insight problems (one mathematical and one verbal), belonging to the category of "unreasonable" problems, which are ill-defined and whose successful problem solver must acquire an insight into the nature of the trick (Perkins, 2000) were used. These were introduced about half way during the course of the study.

A short RAT (Remote Associates Tasks) task (Mednick, 1962), composed of three items created by the author, was also employed.

Finally, the CAQ (Creative Achievement Questionnaire) Carson et al. (2005) was used to assess self reported creative achievement in many different fields (creative writing, visual arts, music, culinary arts, science, inventions, etc.).

Three different scores were obtained from the CAQ. A total score, consisting of the total sum of scores in all sections. Two additional scores were included, according to the two factors solution proposed by (Carson et al., 2005). A Science score, summing up scores in the scientific sections of the CAQ (Invention, Science, Culinary Arts). An Art score, summing up scores in the artistic sections of the CAQ (Drama, Writing, Humour, Music, Visual Arts, Dance).

3 Results

A principal component analysis (PCA) was conducted on all the (17) personality measures with oblique rotation (Oblimin). The KaiserMeyerOlkin measure verified the sampling adequacy for the analysis, KMO= .73 ("good" according to Field, 2009), and all KMO values for individual items were > .6, which is above the acceptable limit of .5 (Field, 2009). Bartlett's test of sphericity c(136) = 666.18, p<.001, indicated that correlations between items were sufficiently large for PCA. An initial analysis was run to obtain eigenvalues for each component in the data. Four components had eigenvalues over Kaiser's criterion of 1 and in combination explained 62.61 % of the variance.

Inspection of the scree plot justified Kaiser's criterion. Given the convergence of the scree plot and Kaiser's criterion on four components, this is the number of components that were retained in the final analysis. Tables 1-2 18–19 (pattern and structure matrix, respectively) show the factor loadings after rotation.

The items that cluster on the same components suggest that component 1 represents Emotional Instability, component 2 Openness to Experience, component 3 Sociability and component 4 (lack of) Impulsivity or Dominance. Component 3 could also be interpreted

as the negative dimension of schizotypy, with component 4 closer to the positive schyzotypal spectrum.

Another principal component analysis was conducted on the 6 divergent thinking tests. The KaiserMeyer-Olkin value was .845 ("great" according to Field, 2009). The correlations between items were sufficiently large for PCA, as indicated by Bartlett's test of sphericity c(15)= 273.77, p<.001.

Only one component had eigenvalue over Kaiser's criterion of 1 and explained 65.21 % of the variance.

Likely, this component represents Ideational Fluency, as the tests were scored for number of answers.

3.1 *Extra predictive signal in the four factors*

Multiple regressions were performed to test the hypothesis that the four factors have extra predictive power (independent from the Big 5, sex and age). The "Ideational Fluency", Insight problems, CAQ Science, CAQ Art, CAQ Total were chosen as outcome variables. O (Openness to Experience), E (Extraversion), N (Neuroticism), A (Agreeableness), C (Conscientiousness), Sex, Age, Factor 1-4 were chosen as independent variables.

Regression with "Ideational Fluency" as outcome variable: the p value for testing whether there is extra predictive signal in factors 1-4 above and beyond that in O, E, N, A, C, sex, age, is .0692.

Insight Problems as outcome variable: the p value for testing whether there is extra predictive signal in factors 14 above and beyond that in O, E, N, A, C, sex, age, is .1403; this is not quite significant at the usual .05 level. However, it can be seen from the regression that factor 2 by itself has extra predictive signal (p<.05).

CAQ Science as outcome variable: CAQ Science had a positively skewed distribution, with nonnegative integer values, making it suitable for consideration for poisson or negative binomial regression; its variance to mean ratio is 2.651382^2 / 2.458333 = 2.8595908, which is much larger than the value of 1 associated with poisson regression.

The negative binomial regression demonstrates convincingly that the poisson model (corresponding to alpha = 0) would be inadequate, and it fits the data reasonably well: the p value for testing whether there is extra predictive signal in factors 14 above and beyond that in O, N, E, A, C, sex, age, is .0067; this is highly statistically significant, and strong evidence that there is extra predictive signal. CAQ Art as outcome variable: A negative binomial regression again demonstrates convincingly that the poisson model (corresponding to alpha = 0) would be inadequate. The p value for testing whether there is extra predictive signal in factors 1-4 above and beyond that in O, N, E, A, C, sex, age, is .3843; the evidence of extra predictive signal for this outcome variable is weak.

CAQ Total as outcome variable: A negative binomial regression again demonstrates convincingly that the poisson model (corresponding to alpha = 0) would be inadequate. The p value for testing whether there is extra predictive signal in factors 1-4 above and beyond that in O, N, E, A, C, sex, age, is .2975; the evidence of extra predictive signal for this outcome variable is also weak.

Summary: p values for outcome signal: Ideational Fluency: .0719; Insight problems:. 1403; CAQScience: .0067; CAQArt: .3843; CAQTotal: .2975. Fisher's method (Fisher, 1925) was used to produce a composite (meta-analysis) p value that summarizes the overall strength of evidence for extra predictive signal in factors 14 above and beyond that in O, N, E, A, C, sex, age, across the k= 5 outcome variables: The quantity A = -2 times the sum of the logarithms (base e) of the 5 p values above would have a chi-square distribution on 2 * k = 10 degrees of freedom under the null hypothesis of no extra predictive signal, if the tests leading to the 5 p values were independent; this produces a value of A of 23.54154 and a raw overall p value (uncorrected for dependence) of 0.008914851; when this is adjusted upward by (2 * 5)/(5 + 1)= 1.666667 to correct for dependence in the tests, the final result is a meta-analysis p value of .0149 and a conclusion of convincing evidence in the data of extra predictive signal in factors 1-4 above and beyond that in O, N, E, A, C, sex, age.

3.2 *Creativity and personality*

Six creativity measures were used as outcomes (RAT, Ideational Fluency, Insight Problems, CAQ Science, CAQ Art, CAQ Total).

Although the four factors and the Big Five have independent predictive power, they largely overlap. In order to avoid multicollinearity, for each outcome variable, two separate regressions were performed, using two sets of predictors. The first set included: O, E, N, A, C, sex, age. The second set included: Factors 1-4, sex, age. RAT as Outcome variable and first set of predictors.

Using the enter method, a significant model emerged (F7, 80= 2.17, p= 0.046). Adjusted R square=0.086. Significant variables are shown below:

Three (negative binomial) regressions were run to explore the effects (independent of personality but including Sex and Age as predictors) of Ideational Fluency and RAT (Remote Associates Test) on CAQ Science, CAQ Art, and CAQ Total.

Table 1: *RAT as Outcome variable and first set of predictors*: Using the enter method, a significant model emerged (F7,80=2.17, p= 0.046). Adjusted R square= 0.086.

Outcome	Predictor	B	p
RAT	Agreeableness	0.447	0.044
	Sex	−0.514	0.049

Table 2: *RAT as Outcome variable and second set of predictors*: Using the enter method, a significant model emerged (F6,78= 2.714, p= 0.019). Adjusted R square= 0.109. Significant variables are shown below.

Outcome	Predictor	B	p
RAT	Factor 3	0.329	0.025
	Sex	−0.668	0.019

Table 3: *Ideational Fluency as Outcome variable and first set of predictors*: Using the enter method, a significant model emerged (F7,77= 4.257, p < 0.001). Adjusted R square = .213. Significant variables are shown below.

Outcome	Predictor	B	p
Ideational Fluency	Openness	0.493	0.000
	Conscientiousness	−0.313	0.005

Table 4: *Ideational Fluency as Outcome variable and second set of predictors*: Using the enter method, a significant model emerged (F6,75= 5.429, p < 0.000). Adjusted R square = .247. Significant variables are shown below.

Outcome	Predictor	B	p
Ideational Fluency	Factor 2	0.513	0.000

Table 5: *Insight Problems as outcome variable and second set of predictors*: Using the enter method, a significant model emerged (F7,18= 3.371, p < 0.022). Adjusted R square = .382. Significant variables are shown below.

Outcome	Predictor	B	p
Insight Problems	Factor 3	−0.465	0.013
	Age	−0.461	0.020

Table 14: *CAQ Total*: Using the enter method, a significant model emerged (LR chi2(4)= 10.656, p<0.031).Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Total	Ideational Fluency	0.237	0.015

Table 6: *CAQ Science as outcome variable and first set of predictors*: A negative binomial regression was performed, using the enter method: a significant model emerged (LR chi2(7)= 38.582, p < 0.000). Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Science	Openness	0.915	0.000
	Agreeableness	0.371	0.020
	Conscientiousness	−0.408	0.010
	Sex	−0.432	0.030

Table 7: *CAQ Science as outcome variable and second set of predictors*: A negative binomial regression was performed, using the enter method: a significant model emerged (LR chi2(6)= 33.780, p < 0.000). Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Science	Factor 2	0.229	0.018
	Factor 4	−0.348	0.003
	Sex	−0.485	0.021

Table 8: *CAQ Art as outcome variable and first set of predictors*: A negative binomial regression was performed, using the enter method: a significant model emerged (LR chi2(7)= 30.867, p < 0.000). Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Art	Openness	0.804	0.001
	Age	−0.039	0.002

Table 9: *CAQ Art as outcome variable and second set of predictors*: A negative binomial regression was performed, using the enter method: a significant model emerged (LR chi2(6)= 30.160, p < 0.000). Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Art	Factor 2	0.426	0.000
	Age	−0.040	0.003

Table 10: *CAQ total as outcome variable and first set of predictors*: A negative binomial regression was performed, using the enter method: a significant model emerged (LR chi2(7)= 37.952, p < 0.000). Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Total	Openness	0.898	0.000
	Agreeableness	0.312	0.024
	Age	−0.022	0.017

Table 11: *CAQ total as outcome variable and second set of predictors*: A negative binomial regression was performed, using the enter method: a significant model emerged (LR chi2(6)= 34.108, p < 0.000). Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Total	Factor 2	0.381	0.000
	Age	−0.022	0.024

Table 12: *CAQ Science*: Using the enter method, a significant model emerged (LR chi2(4)= 18.748, p < 0.001). Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Science	RAT	0.275	0.004
	Sex	−0.545	0.008

Table 13: *CAQ Art*: Using the enter method, a significant model emerged (LR chi2(4)= 9.619, p<0.047).Significant variables are shown below.

Outcome	Predictor	B	p
CAQ Art	Ideational Fluency	0.334	0.007

Table 15: *CAQ Science*: Using the enter method, a significant model emerged (LR chi2(13)= 56.834, p < 0.000). The B and p values for RAT and Ideational Fluency are shown below. Personality variables were not included because of high multicollinearity among them.

Outcome	Predictor	B	p
CAQ Science	RAT	0.186	0.035
	Ideational Fluency	−0.104	0.283

Table 16: *CAQ Art*: Using the enter method, a significant model emerged (LR chi2(13)= 31.026, p < 0.003). The B and p values for RAT and Ideational Fluency are shown below.

Outcome	Predictor	B	p
CAQ Art	Ideational Fluency	0.093	0.458
	RAT	−0.144	0.166

Table 20 shows mean scores on the four personality factors for males and females.

Table 21 shows the results of the independent t-test. Females do not differ significantly from males in components 1 and 2 (p= .81 and .29, respectively). However on average, males scored lower (M= -.41, SE= .21) on component 3 than females (M= .24, SE= .09). This difference was significant t(46.89)= -2.78, p= .008.

Table 17: *CAQ Total*: Using the enter method, a significant model emerged (LR chi2(13)= 39.580, p < 0.000). The B and p values for RAT and Ideational Fluency are shown below.

Outcome	Predictor	B	p
CAQ Total	Ideational Fluency	0.001	0.988
	RAT	−0.037	0.644

On component 4, males scored lower (M= .53, SE= .15) than females (M= .31, SE= .12). This difference was significant t(90)= -4.23, p= .000. Thus, in this sample men and women score very similarly in Openness to Experience and Emotional Instability, whereas men score higher in Impulsivity (or Dominance) and lower in Sociability. As noted earlier, these two components in turn are correlated to various creativity measures (in other words, high dominance and low agreeableness predict higher creativity).

Table 22 shows mean scores on CAQ Total, CAQ Science and CAQ Art for males and females. Table 23 shows the results of the independent t-test.

Females do not differ significantly from males in CAQ Total (p= .268) or CAQ Art (p= .85). However, on average males scored higher (M=3.56; SE= .53) in CAQ Science than females (M= 1.8; SE= .26).

This difference was significant t(90)= 2.97, p< .01.

4 Discussion

4.1 Is there more to creativity than the big 5?

The answer to this question appears to be positive. The four factors I extracted with principal component analyis indicate that there are important dimensions of personality related to creativity other than the Big Five. Two of these four factors (Factors 1 and 2) are very similar to two of the Big Five factors (Emotional Instability/Neuroticism and Openness to Experience). Factors 3 and 4 are different and appear more similar to Eysenck's dimension of Psychoticism. Thus, this study provides partial support for Eysenck's theory of creativity, although it does so indirectly because the original Psychoticism scale was not employed.

Eysenck's theory of creativity was based on the sole dimension of Psychoticism and his failure to consider other important psychological traits is due to his three factor model of personality, which did not include Openness to Experience. Openness to Experience is, in both the literature and in the present study, the strongest predictor of creative achievement and divergent thinking.

With the first predictor model (Big 5 + Sex and Age), Openness to Experience and Conscientiousness (negatively) were the only significant predictors of Ideational Fluency.

With the second predictor model, Factor 2 (Openness to Experience) was the only significant predictor of Ideational Fluency.

It can be seen that Openness to Experience (either in the form of O or Factor 2) significantly predicts all creativity measures, with the exception of Insight problems (although this may be due to the small number of participants involved in the solution of Insight problems).

Scientific and Artistic achievement are predicted by different types of variables. Scientific achievement is positively associated, in order of importance, with being open to experience, high in "Impulsivity or Dominance" (Factor 4, consisting of being low in conscientiousness, cyclothimic, unconventional, risk taking, aggressive and impulsive), less conscientious, agreeable and male.

The only significant personality predictor of artistic achievement is Openness to Experience (O and Factor 2). Sex had no effect but age was a negative predictor. Emotional Instability (N and Factor 1) was not related to artistic achievement. This is surprising, given the often noted association between Neuroticism/Emotional Instability and artistic creativity (Feist, 1998).

The picture for overall creative achievement is the same as that for artistic achievement, with the exception that in this case Agreeableness is a significant and positive predictor.

4.2 *Cognitive traits associated with artistic and scientific achievement*

Scores on the RAT emerged as a significant predictor of scientific achievement both before and after controlling for personality variables. This is in accord with the findings of Datta (1964)'s study, showing a positive correlation between Remote Associates Test scores and ratings of creativity for 21 American-born engineers. It must be noted that the RAT version of the present study consisted only of 3 items. Had the much longer, original version (not available in the Italian language) been used, higher scores could have been found. Ideational Fluency was a significant predictor of both artistic and overall creative achievement, but not of scientific achievement. However, after controlling for personality, Ideational Fluency lost all its predictive power with respect to artistic and total creative achievement.

The relative importance of RAT and Divergent thinking scores (with the former being closer to the convergent pole of thinking) for scientific and artistic achievement is in accord with the expectation of more convergent abilities being required for scientific invention and discovery.

4.3 *Does personality mediate the relationship between sex and scientific achievement?*

As stated earlier, I found significant sex differences in the personality traits (Factor 4) related to CAQ Science.I also found significant sex differences in CAQ Science, with males outperforming females. This suggested the possibility that the male advantage in scientific achievement could be explained by sex differences in personality traits. In order to test this hypothesis, I performed a negative binomial regression with CAQ Science as outcome variable and O, E, N, A, C, sex, age, factors 1-4 as predictors. Sex was still a significant predictor of CAQ Science (B: -.45; p=.025).This suggests that the male advantage in scientific achievement is not mediated by sex differences in personality. I also tested the hypothesis that the male advantage in scientific achievement could be explained by sex differences in cognitive traits (Ideational Fluency and RAT).

In order to test this hypothesis, I performed a negative binomial regression with CAQ Science as outcome variable and Ideational Fluency, RAT, O, E, N, A, C, sex, age, factors 1-4 as predictors. Sex was still negatively related to CAQ Science but this relationship was not significant (B: .269; p=.219).

Thus, cognitive abilities (particularly RAT) appear to mediate the relationship between Sex and scientific achievement.

5 Conclusion

Studies of the personality traits of creative people so far have compared different groups of people, such as scientists vs artists, scientist vs nonscientists, etc (defined by field of study or career path) (Feist, 1998) or have shown the differences between more versus less creative scientists, artists (Feist, 1998) or architects (Mackinnon, 1962). This study employed a new methodology. It addressed a random sample of the population (mostly young people/students) instead of focusing on subsamples that met pre-defined requirements (e.g. field of study, job, etc.) for inclusion. Instead, their scores on a self-report questionnaire of creative achievement (the CAQ) were employed as a measure of lifetime creative output. Moreover, scores on two subscales of this questionnaire were computed, giving two additional scores for scientific

and artistic achievement. These scores were in turn related to personality and cognitive measures.

Despite these methodological differences, the picture that emerged of creative people, scientists and artists is very similar to that found using other methodologies. Variation in the normal range of creativity scores is predicted by the same personality and cognitive traits that predict creativity among exceptional individuals. This brings further evidence to the contention that the same cognitive and personality traits account for creative production from the low to the high levels of achievement.

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Table 18: Pattern Matrix*

	Component			
	1	2	3	4
Seek		.713		
Creative Personality Scale (Gough)		.743		
Openness		.877		
Extraversion		.491		
Violence (Rushton)				-.561
Neuroticism	.689			
Agreeableness			.782	
Conscientiousness				.612
Risk taking				-.720
Unconventionality		.555		-.519
Cyclothymia. Temps-A (Preti et al. 2010)	.677			
Depression. Temps-A (Preti et al. 2010)	.611		-.509	
Irritability. Temps-A (Preti et al. 2010)	.654			
Hyperthymia. Temps-A (Preti et al. 2010)		.729		
Anxiety. Temps-A (Preti et al. 2010)	.722			
Introvertive Anhedonia, O-Life (Mason & Claridge 2006)			-.833	
Impulsive Nonconformaty, , O-Life (Mason & Claridge 2006)				-.766

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
*Rotation converged in 14 iterations.

Table 19: Structure Matrix

	Component			
	1	2	3	4
Seek		.722		
Creative Personality Scale (Gough)		.776		
Openness		.836		
Extraversion		.548		
Violence (Rushton)				-.587
Neuroticism	.745			
Agreeableness			.803	
Conscientiousness				.632
Risk taking				-.657
Unconventionality		.591		-.654
Cyclothymia. Temps-A (Preti et al. 2010)	.762			-.564
Depression. Temps-A (Preti et al. 2010)	.645		-.557	
Irritability. Temps-A (Preti et al. 2010)	.679			
Hyperthymia. Temps-A (Preti et al. 2010)		.759	.412	
Anxiety. Temps-A (Preti et al. 2010)	.697			
Introvertive Anhedonia, O-Life (Mason & Claridge 2006)			-.826	
Impulsive Nonconformaty, , O-Life (Mason & Claridge 2006)				-.785

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Table 20: Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
A-R factor score 1 for analysis 1	Male	34	0.0325023	1.07205339	0.18385564
	Female	58	-0.0190531	0.96442127	0.12663472
A-R factor score 2 for analysis 1	Male	34	0.1446563	1.02277852	0.17540507
	Female	58	-0.0847985	0.98542861	0.12939312
A-R factor score 3 for analysis 1	Male	34	-0.4107716	1.24192648	0.21298863
	Female	58	0.2407972	0.73748566	0.09683661
A-R factor score 4 for analysis 1	Male	34	-0.5316536	0.90258168	0.15479148
	Female	58	0.3116590	0.92596581	0.12158527

Table 21: Independent Samples Test

		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference
A-R factor score 1 for analysis 1	Equal Variances assumed	90	0.813	0.5155533
	Equal Variances not assumed	63.468	0.818	0.05155533
A-R factor score 2 for analysis 1	Equal Variances assumed	90	0.291	1.02277852
	Equal Variances not assumed	67.172	0.296	0.98542861
A-R factor score 3 for analysis 1	Equal Variances assumed	90	0.002	1.24192648
	Equal Variances not assumed	46.893	0.008	0.73748566
A-R factor score 4 for analysis 1	Equal Variances assumed	90	0.000	0.90258168
	Equal Variances not assumed	70.701	0.000	0.92596581

Table 22: Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Total scoreCAQ	Male	36	8.64	7.200	1.200
	Female	60	7.05	6.495	0.838
Science	Male	36	3.555	3.166 29	0.527 72
	Female	60	1.8000	2.048 56	0.264 47
Art	Male	36	5.138	5.737 86	0.956 31
	Female	60	4.9167	5.597 49	0.722 63

Table 23: Independent Samples Test

		t-test for Equality of Means		
		Sig. (2-tailed)	Mean Difference	Std. Error Difference
Total scoreCAQ	Equal variances assumed	0.268	1.589	1.426
	Equal variances not assumed	0.282	1.589	1.464
Science	Equal variances assumed	0.001	1.75556	0.53195
	Equal variances not assumed	0.004	1.75556	0.59028
Art	Equal variances assumed	0.852	0.22222	1.19116
	Equal variances not assumed	0.853	0.22222	1.19864