

# Solitary Minds and Social Capital: Latent Inhibition, General Intellectual Functions and Social Network Size Predict Creative Achievements

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Successful creative accomplishment is influenced by both individual and social factors. The aim of this study was to investigate the relationship between these factors in 111 Central-Eastern European volunteers recruited from the community. Individual factors evaluated in this study included IQ, latent inhibition (LI), and schizotypal personality traits. In addition to these measures, the size of the primary social network (relatives and friends who know and personally contact each other) and the broader network (persons to whom Christmas cards are sent) were evaluated. Result revealed that the personality trait unusual experiences significantly predicted real-life creative achievements. However, when LI was taken into consideration, this relationship did not retain significance. Further independent predictors of creativity were IQ and, most importantly, primary but not broader social network size. These results suggest that decreased LI, higher intellect and stronger social support independently facilitate real-life creative accomplishment.

*Keywords:* creativity, latent inhibition, social network, personality, IQ

What are the predictors of creative accomplishment? Can creativity be conceptualized as an individual trait of solitary, clever, and unusual minds or is it closely related to social networks? These two ideas are often quoted as independent or mutually exclusive hypotheses from the points of view of cognitive science, social psychology and even psychopathology, and so far relatively little empirical work has been done to compare these two hypotheses against each other (Hennessey & Amabile, 2010; Runco, 2004).

Regarding individual differences in cognitive abilities, latent inhibition (LI) and general intellectual functions (IQ) are often considered as cornerstones of creativity (Carson, Higgins, & Peterson, 2003; Eysenck, 1995; Silva, 2008; Sternberg & O'Hara, 1999). LI is a special ability of the nervous system to tune down information that was previously experienced as irrelevant (Lubow, 1989). LI serves an important function in directing the focus of attention away from irrelevant details, and thus facilitating convergent thinking and goal-directed behavior. However, reduced LI can expand the availability of stimuli and mental representations, which may be essential to generate novel and original associations and to intuitively gain insight into complex problems (Simonton, 1988). It has been shown that lower LI is associated with personality traits such as openness to experience and extraversion (Peterson & Carson, 2000; Peterson, Smith, & Carson, 2002), which are marked predictors of divergent thinking and creativity (e.g.,

Feist, 1998; Furnham & Bachtiar, 2008; King, Walker, & Broyles, 1996; McCrae, 1987). Carson et al. (2003) demonstrated an intriguing interaction between LI and IQ in relation to creativity: the highest eminent creative accomplishments were observed in persons with low LI and high IQ. Additionally, persons with decreased LI seem to have a higher faith in their intuition to solve various problems (Kaufman, 2009).

LI may provide a valid link between creativity and psychopathology. Patients with acute schizophrenia and healthy individuals with schizotypal personality traits display decreased LI (Braunstein-Bercovitz, Rammsayer, Gibbons, & Lubow, 2002; Lubow, 2005), and there is evidence that schizotypal traits, such as unusual experiences, broadened conceptual categories and loosened associations, are associated with creativity (Claridge, 1998; Eysenck, 1995).

Altogether, these results suggest that at the individual level creativity is associated with an ability to reach information that is otherwise screened out. General intellectual functions and unusual personality traits may facilitate the generation of original experiences, ideas and novel associations. However, creativity is rarely confined to solitary minds; all creative activities from the generation of new ideas and artistic objects to the acceptance and appreciation of these products are basically social and are influenced by group organization, personal relationship and support, and cultural context (Amabile, 1996; Brass, 1995; Csíkszentmihályi, 1990; Glaveanu, 2010; John-Steiner, 2005). In a seminal report, Simonton (1975) collected information from 127 generations of European history and found that creative eminence and development were affected by social factors ranging from the availability of role models within the specific creative domain to political instability. However, different categories of social relationships have a distinct effect on successful creative achievements (Simonton, 1984, 1992). Within the family domain, positive role models, nourishing environment, and traumatic events were

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equally reported, and the relationship with influential peers, teachers, and mentors is also complex. Simonton (1992) concluded that intimate and remote relationships with cooperative and competitive features are implicated in the genesis of eminent achievements.

Despite the potential importance of the relationship between individual and social factors in creativity (Simonton, 2000), to our knowledge, there is no published study that investigated real-life creative performance, LI, IQ, schizotypal traits, and social networks in the same general population. The aim of this study was to fill this gap in the literature. We hypothesized that LI mediates the relationship between schizotypal traits and creativity, and that higher creative achievement is associated with richer social connections.

## Method

### Participants

Volunteers were 111 Hungarian persons of Central-Eastern European origin (65 men, 46 women) with a mean age of 41.6 years ( $SD = 8.7$ ) and a mean duration of education of 14.6 years ( $SD = 7.6$ ). They were recruited from the community via personal acquaintances, advertisement, and e-mail networks. All volunteers were screened for major psychopathology through personal interviews. Exclusion criteria included psychiatric disorders, substance abuse, and severe medical conditions.

### Creative Achievement Questionnaire (CAQ)

The CAQ measures lifetime creative accomplishment in the fields of art and science with a sound test—retest reliability and convergent, discriminant, and predictive validity (Carson, Peterson, & Higgins, 2005). Participants rated achievements in 10 domains of creative accomplishment (visual arts, music, dance, architectural design, creative writing, humor, inventions, scientific discovery, theater and film, and culinary arts). We weighted the CAQ scores according to the ranking of experts following the method of Carson et al. (2005). For example, in the visual arts domain the participant was asked to mark the statement that best described his or her achievements (e.g., “People have commented on my talent in this area.”, “I have won a prize or prizes at a juried art show.”, “My work has been critiqued in national publications.”). The total CAQ score is the sum of the weighted scores from the 10 domains.

### IQ Measurement

The Wechsler Adult Intelligence Scale—Revised (WAIS-R; Wechsler, 1981) was administered to measure full-scale IQ in each participant.

### LI Task

We applied a visual search version of LI in a within-subject design (Kaplan et al., 2006; Lubow, Kaplan, Abramovich, Rudnick, & Laor, 2000). Participants viewed a computer screen from a distance of 50 cm. They were told that they would see a series of displays containing 20 figures, which were simple black and white

drawings composed of five straight lines (size:  $1.5 \times 1.5$  cm) (see Figure 1). Nineteen of the figures had the same shape and size (distractors) and one figure was different from the others (the target). Stimuli could appear in one of 96 positions created by a  $12 \times 8$  virtual spatial matrix on the screen. The target was exposed in a randomly determined and different position on each trial. On half of the trials the target appeared on the left side of the screen, and on the other half on the opposite side.

Participants were asked to press the left arrow key if the target appeared on the left side of the screen, and to press the right arrow key if the target appeared on the right side of the screen. The display remained on the screen until the participant responded. The interval between the response and the next display was 1.5 s.

After a brief practice block, the preexposure phase was administered. This stage consisted of 96 trials; the target figure and the distractors were always the same across trials. Immediately after the preexposure phase, we administered the test phase. Participants were informed that the task is the same, but now the targets and distractors would vary from trial to trial. The test stage included four different trial-types: (a) the target and distractors were the same as in preexposure phase; (b) the target and distractors were new; (c) the target and distractors were the same as in preexposure phase, but the previous target became distractors, and the previous distractors became the target (preexposure condition); (d) the target was new, and the preexposed target became the distractor (non-pre-exposure condition). The four types of trials appeared 24 times in a random order with no more than two successive identical trial types. The dependent measure was the mean of individual median response time values. Responses longer than 5 s were excluded from the analysis.

The critical comparison regarding LI included the difference between preexposure and non-pre-exposure conditions. The other types of trials were fillers. In the preexposure condition, the reaction time was expected to be longer than in the non-pre-exposure condition as a consequence of LI; in the preexposure phase later test-phase targets appeared as irrelevant distractors and therefore they were inhibited. Larger differences between reaction times on preexposure and non-pre-exposure trials reflect stronger LI.

### Schizotypal Personality Traits

Schizotypal personality traits were assessed with the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason, Claridge, & Jackson, 1995). This instrument is a self-report measure consisting of 159 items with a dichotomous response format. O-LIFE measures four dimensions: (a) unusual experiences, (b) introverted anhedonia, (c) cognitive disorganization, and (d) impulsive nonconformity. Unusual experiences refer to nonordinary subjective phenomena such perceptual aberrations, magical thinking and hallucinatory experiences. Introverted anhedonia includes decreased pleasure and enjoyment from social and physical



Figure 1. Examples of stimuli used in the visual search latent inhibition task.

sources of pleasure and the avoidance of intimacy. Cognitive disorganization refers to loosened association and poor concentration. Finally, the impulsive nonconformity dimension characterizes impulsive, eccentric, aggressive, and asocial traits.

### Social Connections

In order to measure the extent of social connections our participants had, we used the Interview Measure of Social Relationships (IMSR) (Brugha, Sturt, MacCarthy, Potter, Wykes, & Bebbington, 1987), which is a semistructured interview providing data on the number of contacts, the presence of attachment figures, negative and intense interaction, and on the number of members known by each person in the primary group of relatives and friends. The size of the primary group is a reliable measure of objective social support (Brugha et al., 1987; Brugha, 1995). In addition, we determined the broader secondary social network of the participants adapting the method of Hill and Dunbar (2003). This questionnaire focuses on the number of Christmas cards sent to estimate the size of the social network of individuals. In our study, we used the mean number of Christmas cards sent by conventional and electronic mail. Persons belonging in the primary group were not considered in the secondary network.

### Data Analysis

The STATISTICA 8.0 (StatSoft Inc., Tulsa) software was used for data analysis. LI was characterized by the comparison of reaction time values for preexposed and non-pre-exposed conditions with a student's *t* test (two-tailed). We calculated Spearman's correlation coefficients among the variables. Multiple regression analyses were used to determine the predictors of creative achievement as revealed by the CAQ score. First, O-LIFE dimensions were entered as potential predictors. Second, LI (reaction time difference between preexposed and non-pre-exposed condition) was entered as a potential mediator variable between CAQ and schizotypy. Finally, IQ, primary group size, and secondary social network size were entered into the regression analysis to explore how general intellectual functions and social connections contribute to CAQ scores. We used a Sobel test for the mediation analysis. The level of statistical significance was set at  $\alpha < .05$ .

### Results

The descriptive statistics of the sample are depicted in Table 1. The O-LIFE scores were similar to the published values from nonclinical individuals (Mason et al., 1995). Figure 2 shows reaction time from the LI task. As expected, responses were slower in the preexposed than in the non-pre-exposed condition,  $t(220) = 4.50, p < .0001$ , revealing a strong LI phenomenon. However, the mean response time in the filler trials was similar to that observed in the non-pre-exposed condition (mean: 2.0 s,  $SD = 0.6, t(220) = 1.24, p = .21$ ).

Table 2 depicts the correlations among the variables. The first multiple regression analysis including the O-LIFE dimensions as potential predictors of the CAQ score revealed a significant effect only in the case of Unusual Experiences,  $\beta = 0.23, t(106) = 2.31, p < .05$ . In the case of Cognitive Disorganization,  $\beta = -0.02$ , Introverted Anhedonia,  $\beta = 0.01$ , and Impulsive Nonconformity,

Table 1  
*Characteristics of the Sample*

	Mean	SD	Range	Variance
Creative achievement questionnaire	6.1	5.3	0–28	27.8
Latent inhibition	0.3	0.4	–0.6–1.3	0.18
IQ	112.0	14.3	90–143	205.8
Primary network	8.1	4.0	2–19	16.0
Broader network	38.1	30.7	0–130	939.9
Unusual experience	10.2	4.5	2–20	19.9
Cognitive disorganization	9.1	3.2	2–16	9.9
Introverted anhedonia	4.9	2.7	1–12	7.3
Impulsive nonconformity	9.3	4.1	3–21	16.8

$\beta = -0.01$ , there were no significant effects,  $p > .5$ . The overall model was not significant,  $F(4, 106) = 1.42, p = .23, R^2 = 0.05$ .

In the second analysis, LI was added to the O-LIFE dimensions. The effect of Unusual Experience failed to retain significance,  $\beta = 0.15, t(105) = 1.64, p = .10$ , whereas the effect of LI was significant,  $\beta = -0.32, t(105) = -3.35, p = .001$ , similarly to the whole model,  $F(5, 105) = 3.49, p < .05, R^2 = 0.14$ . We formally tested the possibility that LI is a mediator between CAQ and O-LIFE Unusual Experience scores (Baron & Kenny, 1986). However, a Sobel test did not indicate a significant mediating effect,  $p > .5$ .

In the third analysis, IQ was added to the above-described model. Its effect was significant,  $\beta = 0.27, t(104) = 2.98, p < .05$ . LI also remained significant,  $\beta = -0.34, t(104) = -3.64, p < .001$ , similarly to the whole model,  $F(6, 104) = 4.61, p < .001, R^2 = 0.21$ .

In the fourth analysis, the size of the primary and secondary group was entered into the regression model. The predictive effect of the primary group was highly significant,  $\beta = 0.42, t(103) = 4.98, p < .0001$ , but it was not the case for the secondary group,  $\beta = -0.04, t(102) = -0.45, p = .65$ . The model was highly significant,  $F(8, 102) = 7.34, p < .0001, R^2 = 0.37$ . This final regression model is summarized in Table 3.

We also tested a potential gender effect; when gender was included in the abovedescribed analyses, the results remained the same and the effect of gender was not significant,  $p > .5$ .

Finally, we conducted a regression analysis in which we tested the predictors of social network size. As expected from the above reported analyses, in the case of the primary group the single significant predictor was the CAQ score,  $\beta = 0.50, t(103) = 5.18, p < .0001, R^2 = 0.21$ . The O-LIFE dimensions and LI,  $\beta < 0.1, p > .5$ , and IQ,  $\beta = -0.15, p = .1$ , did not reach the level of statistical significance. The whole model was significant,  $F(7, 103) = 5.09, p < .001, R^2 = 0.25$ . In the case of the secondary group, the single significant predictor was Introverted Anhedonia,  $\beta = -0.29, t(103) = -3.06, p < .05$ ; all other  $\beta$ s  $< 0.1, p > .1$ . The whole model was significant,  $F(7, 103) = 2.17, p < .05, R^2 = 0.13$ .

### Discussion

The most important finding of this study is the robust association between primary social network size and real-life creative achievement: the size of the core group of individuals known and

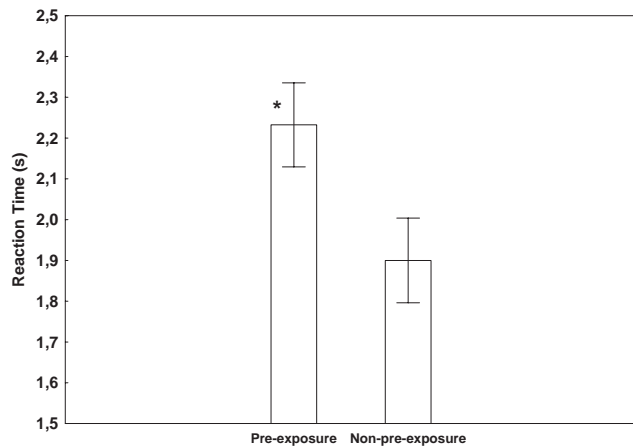


Figure 2. Mean reaction time from the latent inhibition (LI) task. Error bars indicate 95% confidence intervals. \*  $p < .0001$ ,  $t$  test.

personally contacted by each other (relatives and friends) was the strongest predictor of creative success. The size of this primary personal network is a reliable measure of social support (Brugha et al., 1987; Brugha, 1995).

The association between successful creativity and social network size can be explained in two ways. The first explanation is that stronger social support facilitates the emergence of successful creative achievements, or a stronger social network has more resources available to allow creativity to flourish. On the other hand, it is also possible that successful creative achievements promote the growth and adherence of social networks. However, the finding that the size of the broader social network was not related to creativity does not support this second hypothesis. The size of the broader social network was inversely related to introverted personality traits but was unrelated to successful accomplishment.

Regardless of which explanation is more correct, the results support the notion that creativity is a fundamentally social phenomenon (Amabile, 1996; Hennessey & Amabile, 2010; John-Steiner, 2005). In small groups, an optimal balance of both weak and strong ties may be important to facilitate creativity (Parry-Smith & Shelley, 2003; Simonton, 1999; Yong, 2008). A powerful

Table 3  
Summary of the Multiple Regression Analysis: Predictors of the Creative Achievement Questionnaire Score

	$\beta$	Partial correlation	$t(102)$	$p$
Primary network	0.42	0.44	5.0	<0.0001
Latent inhibition	-0.28	-0.31	-3.24	0.002
IQ	0.28	0.32	3.45	0.0008
Broader network	-0.04	-0.05	-0.45	0.65
Unusual experience	0.07	0.08	0.81	0.42
Cognitive disorganization	0.05	0.06	0.60	0.56
Introverted anhedonia	-0.03	-0.04	-0.39	0.70
Impulsive nonconformity	-0.0	-0.0	-0.02	0.98

primary group may promote creativity via its influence on inspiration, extrinsic and intrinsic motivation, well-being, and personal values (Thrash, Elliot, Maruskin, & Cassidy, 2010; Zhou, Shin, Brass, Choi, & Zhang, 2009).

From an evolutionary point of view, Miller (2001) suggested that artistic creativity functions to attract mates. Nettle and Clegg (2006) went further and showed positive associations between unusual experiences and mating success, and impulsive nonconformity and mating success. In the case of unusual experiences, creativity mediated this association, that is, persons with more intensive unusual experiences had a more intensive artistic activity which may increase mating success (Nettle & Clegg, 2006). Mating success may contribute to the development of small groups with strong ties. However, it is not against the possibility that some activities in large groups may enhance creativity. This question should be investigated by the direct assessment of other forms of large group activity (e.g., different types of Internet activity beyond Christmas card sending).

We also investigated individual differences related to creativity and replicated the role of decreased LI and higher IQ in creativity in a general Hungarian population, which is quite different from Harvard undergraduate students assessed by Carson et al. (2003). It is important to note that we used a different LI task, which does not require the inclusion of two separate groups with and without preexposure. This within-subject design and the continuous feature of the LI measure are the major advantages of the visual search analogue of LI. Replication with a different procedure indicates

Table 2  
Spearman's Correlation Coefficients Among the Variables

	LI	IQ	CAQ	Primary network	Broader network	UE	CD	IA	IN
LI	—	0.07	-0.33*	-0.15	0.07	-0.18	0.18	0.02	0.21*
IQ	0.07	—	0.23*	-0.03	0.06	-0.03	-0.12	0.07	0.17
CAQ	-0.33*	0.23*	—	0.47*	0.00	0.22*	-0.01	0.05	0.00
Primary network	-0.16	-0.04	0.47*	—	0.10	0.27*	0.05	0.11	0.02
Broader network	0.07	0.06	0.00	0.10	—	-0.08	-0.12	-0.27*	0.07
UE	-0.18	-0.03	0.22*	0.27*	-0.08	—	0.09	0.21	0.00
CD	0.18	-0.11	0.00	0.05	-0.12	0.09	—	0.01	0.04
IA	0.02	0.07	0.05	0.11	-0.26*	0.21*	0.01	—	0.05
IN	0.21*	0.16	0.00	0.03	0.07	0.00	0.04	0.05	—

Note. LI = Latent Inhibition; CAQ = Creative Achievement Questionnaire; UE = Unusual Experiences; CD = Cognitive Disorganization; IA = Introverted Anhedonia; IN = Impulsive Nonconformity.

\*  $p < .05$ .



that the relationship between LI and creativity is not task-dependent.

There is empirical evidence that schizotypal personality traits are associated with creativity, although the magnitude and pattern of the relationship are not consistent across studies and depend on the instruments used for the assessment (e.g., Batey & Furnham, 2008; Burch, Pavelis, Hemsley, & Corr, 2006; Cox & Leon, 1999; Nelson & Rawlings, 2010; Nettle, 2006; Schulzberg, 1990). In addition, the O-LIFE questionnaire overlaps with the dimensions of other personality measures (Mason et al., 2005). A meta-analysis on personality and creativity focusing on the "Big Five" dimensions indicated that creative persons are more open to new experiences, extraverted, less conventional and less conscientious, more self-confident, ambitious, dominant, hostile, and impulsive (Feist, 1998). Miller and Tal (2007) found that positive schizotypy, including unusual experiences, correlated with both openness and creativity. However, in a regression model, intellect and openness were the predictors of creativity (Miller & Tal, 2007) and schizotypy did not retain its predictive value.

Claridge and Blakey (2009) demonstrated that schizotypy and affective temperament are overlapping constructs and are related to different aspects of creativity. For example, unusual experiences of O-LIFE correlated with cyclothymic temperament, and these were related to belief in unconscious processes and use of senses (Claridge & Blakey, 2009).

The relationship among cognitive inhibition, schizotypy and creativity is not straightforward. Beech, Baylis, Smithson, and Claridge (1989) showed that low automatic inhibition on negative priming tasks is associated with schizotypy. It was plausible to hypothesize that reduced cognitive inhibition mediates the relationship between schizotypy and creativity (Eysenck, 1995). Stavridou and Furnham (1996) found a relationship among psychoticism, low cognitive inhibition and creativity, but by using other types of instruments and personality measurements, Green and Williams (1999) did not find evidence for this relationship. Wuthrich and Bates (2001) and Burch, Hemsley, Pavelis, and Corr (2006) did not confirm the hypothesis that lower LI may mediate the relationship between various aspects of schizotypy, other personality traits and creativity.

It is very difficult to obtain a coherent picture because of the high diversity of methods used in these studies. For example, Eysenck's psychoticism is similar to the impulsive nonconformity dimension of the O-LIFE but not to positive schizotypy (unusual experiences) (Eysenck & Eysenck, 1975; Mason et al., 1995). Another problem is that cognitive inhibition and creativity are measured and analyzed in many different ways in various populations. For example, when low cognitive inhibition was measured via incidental learning, the authors found a significant association with O-LIFE unusual experiences (Burch, Hemsley, Corr, & Gwyer, 2006).

There is a long-lasting debate on the role of mental disorders in creativity (e.g., Andreasen, 1987; Jamison, 1993; Kaufman, 2001; Sass, 2001, but see Schlesinger, 2009; Waddell, 1998). Although schizotypy may represent a susceptibility factor for psychosis (Claridge, 1997), variations on O-LIFE can be considered as normal phenomena in the general population, and the term "schizotypal" might sound stigmatizing. Indeed, genetic polymorphisms (Kéri, 2009) and structural brain variations linked to mental illness (Jung, Grazioplene, Caprihan, Chavez, & Haier, 2010)

are associated with creativity in healthy individuals. Instead of a rigid categorical distinction (disordered vs. normal, creative vs. noncreative), a dimensional approach would be much more fruitful in the research of various individual traits and creative achievements (Glazer, 2009). The present study highlighted two important features that are related to successful creativity but are disrupted in severe mental disorders: IQ and social network. In more than 7000 individuals hospitalized with various mental disorders, Urfer-Parnas, Mortensen, Saebye, and Parnas (2010) demonstrated that decreasing IQ was associated with an increasing risk of becoming a patient regardless of the diagnosis (affective illness, schizophrenia, and personality disorders). The reduction of social network size and support is also a well-known feature of severe mental disorders (Brugha, 1995). In the sample of Cox's 282 geniuses, Simonton and Song (2009) demonstrated a remarkable relationship among eminence, intellect, and early mental health. According to this comprehensive analysis, IQ was a mediator between eminent achievement and mental health. Therefore, studies that found lower creative achievements in mental illness (Waddell, 1998) may reflect the consequence of impaired intellect and disrupted social support in patients relative to controls.

A major limitation of our study is that the assessment of the two social variables—primary network and the broader network—used different measurement techniques. The primary social network was assessed by a semistructured interview, whereas the broader social network was characterized by the Christmas card mailing list. Multiple factors may influence such a list, including religion, professional relationships, and friendships. In addition, personality traits might correlate differentially with the two measures in a manner that reflects the difference between face-to-face interview versus revealing a mailing list. Further studies are warranted to test this possibility using standardized personality measures in addition to O-LIFE. Another limitation is that personal acquaintance recruitment could lead to a bias toward participants with similar cultural background and personal values, and the exclusion criteria were not confirmed by structured interviews.

In conclusion, we demonstrated that LI, IQ, and the size of primary group including family members and friends predicted creative achievements. These results may provide an important contribution to the understanding of the development and support of creative potentials.

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