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FRANCK ZENASNI
MAUD BESANÇON
TODD LUBART

Creativity and Tolerance of Ambiguity: An Empirical Study

ABSTRACT

This study examines the relationship between creativity and tolerance of ambiguity. Participants were parents and their adolescent children. Three measures of creativity were used: a divergent thinking task, a story-writing task and self-evaluation of creative attitudes and behavior. Participants completed two self-report measures of tolerance of ambiguity: the short version of the "Measurement of Ambiguity Tolerance" (Norton, 1975; Zenasni & Lubart, 2001) and the "Behaviour Scale of Tolerance/Intolerance for Ambiguity" (Stoycheva, 1998, 2003). Tolerance of ambiguity was significantly and positively related to creativity. Creativity of parents was related to their adolescents' creativity. However, parents' tolerance of ambiguity was not related to adolescents' tolerance of ambiguity or creativity.

Key words:

Creativity, tolerance of ambiguity, parents, adolescents, personality

INTRODUCTION

Creativity refers to the capacity to produce work that is both original, and adapted to the constraints of the situation (Lubart, 1994; Lubart, Mouchiroud, Tordjman & Zenasni, 2004, Sternberg & Lubart, 1995). Creativity is a natural tendency in every individual, which expresses itself to varying degrees. According to Sternberg and Lubart (1995), creativity depends on several different components. This multivariate approach proposes that intellectual abilities, knowledge, cognitive style, personality traits, motivation and a favorable environment are important factors for creativity. The presence of each of these components and their interaction allows the emergence of creativity. This article will focus on tolerance of ambiguity as a personality trait that is involved in creativity.

RELATIONSHIP BETWEEN TOLERANCE OF AMBIGUITY AND CREATIVITY

A relation between tolerance of ambiguity and creativity has often been proposed but empirical studies are rare. Tolerance/intolerance of ambiguity is generally considered to be a personality trait that corresponds to the way in which an individual tends to perceive and deal with ambiguous situations or stimuli (Furnham, 1994; Furnham & Avison, 1997; Furnham & Ribchester, 1995; Stoycheva, 1998, 2003). Individuals who are tolerant of ambiguity like ambiguous situations, or at least can live with them for some time (MacDonald, 1970). People who are intolerant of ambiguity feel constrained, anxious or tense in ambiguous situations. Vernon (1970) considered tolerance of ambiguity to be a *sine qua non* factor of creativity. Vernon (1970) explained that tolerance of ambiguity favors creative thinking and behaviors because it enables individuals to not be satisfied by partial or non-optimal solutions to complex problems. People who tolerate ambiguity may be able to work effectively on a larger set of stimuli or situations, including ambiguous ones, whereas intolerant individuals will avoid or quickly stop treating such information. In fact, tolerance of ambiguity allows individuals to optimize creative potential, which is not blocked due to unsolved ambiguity.

Other authors have suggested that the more individuals tolerate ambiguity, the more they are creative (Barron & Harrington, 1981; Golann, 1963; Sternberg & Lubart, 1995; Urban, 2003). This hypothesis is based on the idea that situations requiring creative thinking often involve ambiguity. The more a person can tolerate ambiguous objects, the more the person can deal with them. Thus, tolerance of ambiguity will allow individuals to continue to grapple with complex problems, to remain open, and increase the probability of finding a novel solution. For Stoycheva (1998, 2003), tolerance of ambiguity is linked to creativity because ambiguity-tolerant individuals are able to accept feelings of anxiety and psychological discomfort naturally provoked by ambiguity associated with new, difficult situations. Additionally based on Urban's (2003) components model of creativity, tolerance of ambiguity is believed to contribute to the creative process because it empowers the intrinsically motivated exploration of novel, unusual or complex stimuli.

In spite of these theoretical proposals, empirical research has rarely tested the relations between tolerance for ambiguity and creativity. In 1990, Tegano, using the Tolerance of Ambiguity Scale (AT-20, Mac Donald, 1970) observed a positive correlation ($r = .31$, $p < .05$) between early educators' tolerance of ambiguity and their MBTI creative style score. Furnham and Avison (1997) observed a significant link between tolerance of ambiguity and preference for surrealist paintings. These results suggest a positive relation between tolerance of ambiguity and some aspects of creative behaviors: the Myers-Briggs Inventory evaluates some characteristics linked to creativity but not creative production itself, and the preference for surrealist paintings is only a partial aspect of creative attitudes. These studies are demonstrative but include specific measurements more related

to creative style of preferences than creative performance. Only Comadena (1984) examined creative performance of 76 undergraduates in brainstorming groups and observed that tolerance of ambiguity was positively linked to the number of produced ideas. Given these results, it would appear helpful to test the relationship between tolerance of ambiguity and creativity with measurements including the originality of productions.

TOLERANCE OF AMBIGUITY AND PARENT AND CHILD CREATIVITY

Numerous studies have reported effects of family environment on creativity (see Kerr and Chopp, 1999; Walberg et al., 1980). Kerr and Chopp (1999) indicate that there is a significant positive relationship between parents' creativity and the creativity of their children, which is in line with cases showing that eminent creators tend to be themselves the children of one or two famous creators.

Kerr and Chopp (1999) also indicate that parenting style may have a significant impact on creativity. For example, a non-rigid parenting style favors expression and independence and therefore supports originality. Moreover some argue that creative individuals come from unhappy, disordered and difficult family environments (Albert, 1992) whereas others argue that a positive family environment favors creative potential (Csikszentmihalyi, 1996).

Finally, the parents' personality may influence the creativity of their children. Runco and Albert (2005) examined how family-related variables may influence giftedness of children. Using the California Personality Inventory, divergent thinking tests and the Biographical Inventory of Creativity, Runco and Albert explored personality profiles of exceptionally gifted students and their parents. Exploring two groups of gifted boys (one group with exceptionally high IQ and one group with exceptional math-sciences abilities) their results indicate some significant relationships between parents' and children's personality. For the math science sample they observed that both Masculinity-Femininity and Type A behavior scales show father-son correlations ($r = -.53$ and $.42$ respectively). For the high IQ sample, they observed moderate to strong correlations between social poise, leadership and Type A scores of parents and those of their children (regardless of the sex of the parent).

The present study is an original contribution to examine the relationship between tolerance of ambiguity and creativity. Based on the literature, we hypothesized that the more individuals (children and adults) are tolerant of ambiguity, the greater their creative potential and the more they will show creative productions. Second we tested whether (1) the creativity of parents relates to the creativity of their adolescent children, (2) parents' tolerance for ambiguity relates to tolerance of ambiguity of their children and (3) parents' tolerance of ambiguity is linked to their children's creativity. Although the issue has never been explored empirically, based on general postulates of development (biological and environmental transmission from parents to their children), we expect positive relationships between parents' and children's levels of tolerance of ambiguity and creativity.

EMPIRICAL STUDY METHOD

Participants

Sixty-eight French volunteer participants consisting of 34 pairs of adolescents and their parents, took part in this study. Adolescents ranged in age from 11 to 17 (mean age = 15.85; SD = 1.61). There were 14 girls and 20 boys. Parents ranged in age from 39 to 61 (mean age = 48.31; SD = 4.71). There were 28 mothers and 6 fathers. All participants were volunteers, recruited by announcements made by university students to families with secondary school students. Adolescents had to indicate which parent spent the most time and knew him or her best. Then, this parent was requested to participate. Among these 34 dyads, 17 were mixed (14 mother/son and 3 father/daughter) and 17 were non mixed (14 mother/daughter and 3 father/son).

The study was described as focusing on relations between personality and problem solving. Participants provided informed consent, did not receive any payment and were debriefed fully after completing the session.

MATERIALS

Measures of creativity

In order to examine distinct facets of creativity we used three independent measures of creativity: a divergent thinking task, a story-writing task and self-evaluation of creative attitudes and behavior. Because these tasks already vary in terms of type of measurements, we decided to focus on the same type of production (*i.e.* verbal) in order to limit differences between tasks.

The divergent thinking task was based on the generation of ideas concerning an ambiguous stimulus. This stimulus was selected during a pre-test in which 68 adults judged the ambiguity of a large set ($n = 89$) of stimuli (both images and verbal material). Participants used a five-point Likert scale (from 1 “not ambiguous” to 5 “very ambiguous”) to evaluate the degree of ambiguity of each stimulus. There was good inter-judge agreement ($\alpha = .93$ and mean r between judges = .29). The selected stimulus — an ambiguous text — showed a high level of ambiguity (mean = 4.06) and a relatively good degree of consensus between judges' ratings (SD = 1.09).

For the divergent thinking task, participants had to “write as many titles as possible for the ambiguous text”. They had to generate original titles different from those that others may produce. To measure performance, three scores were examined for each participant: (1) fluency (raw number of relevant responses), (2) originality, and (3) unicity (number of unique ideas generated). The evaluation of the originality score was based on the frequency of the occurrence of ideas in the whole sample. We used the additive method proposed by Runco, Okuda and Thurston (1987). In this technique, the relative frequency of each idea in a sample is computed, so that each response can be attributed a score between $1/N$ (unique ideas in a sample of N participants) and $N/N = 1$

(representing ideas proposed by every participant in the sample of N). This score is then subtracted from 1, so that high scores correspond to rare ideas. Finally, summing the results of this computation for each participant and dividing by the number of ideas generated yields the mean originality score. This technique has demonstrated a good discriminative validity (Mouchiroud & Lubart, 2001) and enhances the independence between originality and fluency scores. Moreover divergent thinking task are reasonable predictors of creativity and usually present correct internal reliabilities (Runco, 1991)

The story-writing task was also based on an ambiguous stimulus. Participants were asked, "to imagine an original story different from the stories that others would probably propose". The selected stimulus was a picture presenting a high degree of ambiguity (mean = 3.65) and a good consensus (Standard deviation between judge's evaluations = 1.25).

For each participant, a creativity score was calculated based on the average score of three independent judges' evaluation of the participant's story. Three judges (two females, one male; mean age = 22,5; SD = .70) evaluated the creativity of the stories using a seven-point Likert scale (1 = "slightly creative"; 7 = "highly creative"). Judges evaluated separately the creativity of adolescents' stories and those of parents. Inter-judge' agreement was satisfactory (respectively $\alpha = .82$ and $\alpha = .83$, for adolescents' stories and parents' stories).

The Creative Personality Scale from the Adjective Check-List (ACL, Gough & Gendreau, 1982) was also used to evaluate creativity. This scale includes adjectives that are indicative (the scores are adjusted for the number of adjective checked) (18 adjectives) or contraindicative (12 adjectives) of creative attitudes and behaviors. High scores are attributed to individuals who select adjectives similar to those selected by a criterion group of nominated creative people who completed the same checklist. The 30 adjectives in the creative personality scale are embedded in a list of 300 adjectives. Scores are adjusted for the total number of adjectives checked.

Measures of tolerance of ambiguity

In order to operationalize tolerance/intolerance of ambiguity, two distinct self reports were used.

We first used a short version of the French adaptation of the "Measurement of Ambiguity Tolerance" (Norton, 1975; Zenasni & Lubart, 2001). Norton postulated a bipolar continuum between tolerance of ambiguity and intolerance of ambiguity. This measure includes 27 assertions linked to ambiguous behavior. Subjects used a seven-point Likert scale (from 1 "entire disagreement" to 7 "entire agreement"). A high score on this questionnaire indicates that an individual is intolerant of ambiguity. The MAT shows good internal reliability ($\alpha = .78$) and stability (test retest correlation $r = .80$). Internal reliability for the short form version of the MAT used in the present study will be presented in the results section.

Stoycheva (1998, 2003), in order to evaluate adolescents' and parents' responses to uncertainty in life, constructed the Behaviour Scale of Tolerance/Intolerance of Ambiguity (BSTIA). To create this measure, a large sample of behavioral characteristics indicative or contraindicated of AT was compiled from the research literature. Fourteen items (7 referring to intolerance-of-ambiguity behaviors and 7 items referring to tolerance-of-ambiguity behaviors) which are thematically related were retained based on experts' evaluations and social desirability (Stoycheva, 1998, 2003). For this final questionnaire, subjects used a five-point Likert scale (from 1 "behavior usually encouraged" to 5 "behavior rarely encouraged") for each item¹. Three scores are calculated: a tolerance score, an intolerance score and a global score. A high global score indicates that an individual is intolerant of ambiguity. Original data concerning this scale (Stoycheva 1998) indicate that coefficients of internal consistency of these scales range from .62 to .74. Internal reliabilities of these scales for the present study will be presented in the results section.

Procedure

Participants provided informed written consent. Then, the divergent thinking task was completed during 10 minutes. After a 5-minute break, each participant completed the story-writing task. Fifteen minutes was allowed to write the story. Finally, participants completed the Adjective Check List, the Measurement of Ambiguity Tolerance, and then the Behavior Scale of Tolerance/Intolerance for Ambiguity. Note that for all participants a list of definitions for difficult words from the Adjective Check-List was available during completion of the task. Moreover, the investigators were available to answer questions during the testing procedure. Participants were allowed to complete the last questionnaires at their own pace. Debriefing information was provided

RESULTS

First, we provide analyses concerning the creativity measures. Descriptive analyses, links between distinct measures of creativity, and relations of between parents' and children's creativity are presented. Next, the same kinds of analyses are presented for tolerance of ambiguity measures. In a third section, relations between creativity and tolerance of ambiguity are examined. Because of multi testing, we may consider for all the statistical tests a stricter p value than usual ($p = .01$). For correlational analyses all effect sizes will be discussed according to Cohen's criteria (Cohen, 1988): $r < |0.1|$: no relationship; $|0.1| - < |0.3|$: weak relationship; $|0.3| - < |0.5|$: moderate relationship; $|0.5| - < |0.7|$: strong relationship; $> |0.7|$: very strong relationship.

ANALYSIS OF CREATIVITY MEASURES

Descriptive analyses of the different creativity scores are presented in Table 1.

¹ Note that the ACL and BSTIA's scales have in common the term "original". Potential correlation between these two measurements could be particularly influenced by this one common term.

TABLE 1. Means, minimum and maximum scores, standard deviations of creativity scores.

<i>Sample</i>	<i>Scale</i>	<i>Dimension</i>	<i>Mean</i>	<i>Min</i>	<i>Max</i>	<i>SD</i>
Whole sample	Divergent thinking	Fluency	5.64	1	19	3.08
		Originality	.96	.90	.99	.02
		Uniqueness	2.82	0	10	2.43
	Story writing	Creativity rating	4.04	1	7	1.44
	Adjective Check List	Creative profile	.03	-.05	.15	.04
Parents	Divergent thinking	Fluency	6.27	1	19	3.74
		Originality	.96	.92	.99	.02
		Uniqueness	3.42	0	10	2.57
	Story writing	Creativity rating	3.98	1	5.67	1.29
	Adjective Check List	Creative profile	.03	-.05	.10	.04
Adolescents	Divergent thinking	Fluency	5	2	10	2.12
		Originality	.96	.90	.99	.026
		Uniqueness	2.21	0	8	2.15
	Story writing	Creativity rating	4.10	1	7	1.59
	Adjective Check List	Creative profile	.04	-.05	.15	.04

Using the complete sample, correlational analyses were conducted to evaluate relations between distinct creative measurements (see table 2).

TABLE 2. Correlations between creativity measures.

	(2)	(3)	(4)	(5)
Fluency (1)	.11	.75***	.25	.15
Originality (2)		.56***	.00	.19
Uniqueness (3)			.13	.22
Creative profile (4)				-.08
Story creativity (5)				

Note: N = 68; ** = $p < .01$; *** = $p < .001$

Creative profile measured by the ACL does not correlate with divergent thinking and story writing scores (all p value $> .05$). As expected, the number of unique ideas is linked to fluency and originality ($r = .75$ and $r = .56$, $p < .001$ respectively). Principal Component Factor analysis indicates a 2 factor solution (Kaiser criterion) explaining 63.8% of the variance. After a Varimax rotation, the two factors accounted for 34.9% and 31% of variance respectively. Fluency and the ACL creative score loaded on the first factor. Mean originality and story writing creativity ratings loaded on the second factor. The number of unique ideas loaded on both factors. These results suggest that divergent thinking, ACL creative score and story writing represents partially distinct facets of creativity.

To examine relations between creativity of parents and creativity of their children, we conducted correlational analyses. Results indicate that mean originality of parents is moderately linked to mean originality of their children ($r = .46$, $p = .008$). Moreover, results indicate that the more the parents have a higher ACL creative score, the more their children also report one ($r = .50$, $p = .004$). The fluency, uniqueness of ideas, and story creativity of parents are not correlated with that of adolescents ($r = .16$, $r = .06$, $r = .06$ respectively). Also we calculated a canonical correlation to examine the overall relation between all creativity measures for parents and for adolescents. Results indicate a significant canonical correlation between the two sets of variables ($R_c = .74$, $\chi^2(25) = 41.44$, $p < .05$). The more parents are creative, the more their children tend to be as well. The results of this canonical correlation should be considered tentative, however, because our sample is relatively small for this kind of analysis (reliable estimates require $N = 20 \times$ the number of variables; Stevens, 1986).

ANALYSIS OF TOLERANCE OF AMBIGUITY SCALES

Descriptive analyses of the different tolerance of ambiguity scales are summarized in Table 3.

Including all participants, analyses indicate that the 27-item version of the MAT presents a satisfactory internal consistency ($\alpha = .71$). For adults, the tolerance and the intolerance of ambiguity scales of the BSTIA also present satisfactory internal consistencies ($\alpha = .75$ and $.81$ respectively). Internal consistency of the total scale is good ($\alpha = .86$). For adolescents, all the scales of the BSTIA present low internal reliabilities ($\alpha = .56$ and $.57$ for the tolerance and the intolerance scale, and $\alpha = .61$ for the total scale.)

Correlational analyses (see table 4) indicate that intolerance of ambiguity evaluated by the MAT is moderately and significantly linked to intolerance of ambiguity and tolerance of ambiguity measured by the BSTIA ($r = .33$ and $r = -.44$, $p < .01$ respectively). It is also moderately linked to the global score of intolerance of ambiguity of the BSTIA ($r = .46$, $p < .001$). Note that tolerance and intolerance for ambiguity scores from the BSTIA are correlated ($r = -.42$, $p < .001$). Factor analysis yields a one-factor solution (56.55% of variance), in which intolerance of ambiguity measured by the MAT and the BSTIA are opposed to the dimension tolerance of ambiguity measured by the BSTIA.

TABLE 3. Means, minimum and maximum scores, standard deviations of tolerance/intolerance of ambiguity scores.

Sample	Scale	Dimension	Mean	Min.	Max.	SD
Whole sample	MAT	Intolerance for ambiguity	121.65	82	173	17.68
	BSTIA	Tolerance for ambiguity	15.06	7	25	4.01
		Intolerance for ambiguity	15.80	8	24	3.67
		Total score	35.66	22	50	6.31
Parents	MAT	Intolerance for ambiguity	119.15	82	173	20.69
	BSTIA	Tolerance for ambiguity	16.67	8	24	3.84
		Intolerance for ambiguity	19.52	10	28	4.53
		Total score	36.21	22	50	7.58
Adolescents	MAT	Intolerance for ambiguity	123.54	87	159	15.75
	BSTIA	Tolerance for ambiguity	14.94	10	23	3.35
		Intolerance for ambiguity	20.35	14	27	3.43
		Total score	35.29	26	48	5.26

TABLE 4: Correlations between tolerance/intolerance of ambiguity dimensions.

	(2)	(3)	(4)
Intolerance of Ambiguity (MAT) (1)	-.44***	.33**	.46***
Tolerance of ambiguity (BSTIA) (2)	1.00	-.42***	-.86***
Intolerance of Ambiguity (BSTIA) (3)		1.00	.83***
Total intolerance of ambiguity (BSTIA) (4)			1.00

Note : N = 68 ** = $p < .01$; *** = $p < .001$

Correlational analyses indicate that there are no significant relations between parents' tolerance/intolerance of ambiguity scores and those of their children ($r = -.04$ to $r = .26$).

RELATION BETWEEN TOLERANCE OF AMBIGUITY AND CREATIVITY

First we analyze relationships between tolerance of ambiguity and creativity for the total sample (parents and adolescents). Correlations are presented in table 5.

TABLE 5. Correlations between creativity and tolerance/intolerance of ambiguity.

	Intolerance of Ambiguity (MAT)	Tolerance of Ambiguity (BSTIA)	Intolerance of Ambiguity (BSTIA)	Total Intolerance of Ambiguity (BSTIA)
Fluency	-.38*	.36*	-.36*	-.42**
Originality	-.25	.12	.20	.04
Uniqueness	-.36*	.28	-.16	-.26
Story creativity	-.26	.14	-.10	-.20
Creative personality	-.38*	.08	-.25	-.14

Note: N = 68 ; * = $p < .01$; ** = $p < .001$

The results indicate that fluency is moderately and significantly linked to all scores of tolerance/intolerance of ambiguity ($p < .01$). The more individuals tolerate ambiguity, the more they generated ideas in a divergent thinking task involving an ambiguous stimulus. The number of unique ideas is also significantly linked to intolerance of ambiguity measured by the MAT. Relations of tolerance of ambiguity and other creativity facets are less obvious and do not reach a $p < .01$. However, we may note that all these correlations present the same tendency: it appears that the more individuals are intolerant of ambiguity (measured by the MAT), the less they generated original and unique ideas, the less they produced creative stories and the lower they scored on the adjective checklist measure.

Canonical analyses indicate that the set of creativity scores shared a significant part of variance with tolerance of ambiguity variables (MAT and BSTIA total scores) ($R_c = .57$, $F(8,116) = 4.20$, $p < .001$).

These results support our first hypothesis that the more individuals tolerate ambiguity, the more they tend to be creative.

To complete the examination of relations between tolerance of ambiguity and creativity, we calculated correlations between parents' tolerance of ambiguity and adolescent's creativity. There were no significant relations. Even though creativity of adolescents may be related to the creativity of their parents, it is not significantly related to parents' tolerance of ambiguity.

DISCUSSION

Two main sets of hypotheses were examined. The first one concerned the general relationship between creativity and tolerance of ambiguity. According to our expectations, the results show globally a significant positive relation between creativity and tolerance of ambiguity. The more individuals are tolerant of ambiguity, the more they tend to be creative (generated original and unique ideas, produce creative stories, report creative characteristics). The present results are consistent with previous work finding that tolerance of ambiguity was positively linked to certain indicators of creative behavior (respectively, brainstorming, MBTI creative style score and artistic preferences). The current results show the validity of the positive relation between creativity and tolerance of ambiguity for a more diverse set of creativity assessments. The results are stronger for fluidity and uniqueness than for originality scores.

The second set of hypotheses concerns developmental issues. We examine if there is a link between parents and their children concerning creativity, tolerance of ambiguity and finally parents' tolerance of ambiguity and children's creativity.

The correlational data showed a significant positive relation between parents' creativity and the creativity of their children, which is in line with cases showing that eminent creators tend to be themselves the child of one or two famous creators (Kerr & Chopp, 1999).

However, contrary to our expectations, correlational analyses did not show significant links between parents' tolerance of ambiguity and their adolescent's tolerance of ambiguity or creativity. One explanation is that during adolescence, personality may not be stable. In general, instable characteristics indicate "noise in the system" leading to low reliability for scores and consequently relatively low correlations with other external variables such as creative performance scores. In line with this position, links between creativity and tolerance of ambiguity were stronger for parents (who have a potentially more stable personality and cognitive system) than for adolescents. Further developmental studies are needed. For example, it would be interesting to study the relation between tolerance of ambiguity in parents and children before the entrance in the period of adolescence.

One limit of the present study is the range of ages of adolescents, which varies from 11 to 17 years. In this age range, there may be significant changes in terms of personality, which are not taken into account in the present research. Another limit is the lack of measures of verbal abilities. Because we studied links between questionnaires (including verbal items) with creative verbal performance, part of common variance between creative performances and tolerance for ambiguity may be partially explained by the ability to treat verbal information. One way to resolve this limit in future studies will be to include measurements of figural creativity and direct measures of verbal ability.

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