

TOLERANCE OF AMBIGUITY, OPENNESS TO EXPERIENCE, AND CREATIVITY IN UNDERGRADUATES: A NARRATIVE REVIEW

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ABSTRACT

Creativity is widely considered to be a core competency for learners and graduates in rapidly changing environments; personality research has identified two dispositions as relevant to creativity repeatedly: openness to experience (OE) and tolerance of ambiguity (TOA). This narrative review examined how OE, TOA and creativity are related (with particular attention to university undergraduates). The review clarifies the three constructs and their measures, summarizes evidence for OE–creativity, TOA–creativity and OE–TOA associations, compares theoretical accounts linking them together and proposes an integrative model in which TOA may explain how openness translates into creative thinking and achievement. Evidence for an OE–creativity link is substantial and comparatively consistent. Evidence for a TOA–creativity link is positive but less strong, relies heavily on self-report, and is concentrated in a small number of research groups. Formal tests of TOA as a mediator were not found. The review closes with methodological recommendations and a research agenda for undergraduate samples, including cross-cultural and longitudinal designs, and with implications for educators who wish to foster creativity as a student strength.

I. INTRODUCTION

Creativity, the capacity to produce ideas, products, or solutions that are both novel and valuable (Sternberg, 2006), is frequently cited as an essential skill in science, technology, education, business, and the arts, and as a strength that helps individuals thrive in an increasingly complex and rapidly changing world. Empirical research on creativity is usually traced to the work of Guilford and Torrance, who described creativity largely in terms of divergent thinking, that is, the ability to generate multiple, original responses to an open-ended problem. Torrance's tests of creative thinking remain among the most widely used creativity measures (Sternberg, 2006; Torrance, 1966). Because individuals differ markedly in creativity, a substantial line of research has explored the stable characteristics associated with creative thinking and achievement. Two constructs are repeatedly studied. Openness to experience (OE), one of the Big Five personality dimensions, reflects curiosity, imagination, and willingness to engage with new ideas and experiences (McCrae & Costa, 1997). Tolerance of ambiguity (TOA) describes how a person responds to uncertain, incomplete, or conflicting information, either as a source of threat to be avoided or as a situation that can be engaged with calmly and even with interest (Budner, 1962; Furnham & Ribchester, 1995).

Openness and risk-taking have also been identified as traits associated with creative people (Karpova et al., 2013). Curiosity and creativity are natural objects of study for positive psychology (which is about identifying and developing human strengths), so understanding the dispositions that support them is practically interesting; university students are a good population to study. They are at a developmental stage marked by considerable change in thinking styles, and their dispositions are still being consolidated. Higher education also explicitly aims to foster innovation and problem solving, and therefore creativity. Yet much of the OE, TOA and creativity theoretical writing is not specific to this group and few studies combine all three constructs together. This review therefore has three aims: to synthesize what is known about the pairwise relationships among OE, TOA, and creativity; to evaluate theoretical accounts that connect them; and to identify gaps that matter for research on, and the education of, undergraduates. Three research questions guide the review. First, how consistently are OE and TOA each associated with creativity? Second, how are OE and TOA related to one another, and are they empirically distinct? Third, is there theoretical and empirical support for TOA as a mechanism through which OE contributes to creativity? Because this is a narrative review, the propositions offered later are framed as hypotheses for future testing rather than as established conclusions.

Conceptual Foundations

Creativity

Creativity is the capability to produce new ideas, solutions, and products that are both original and valuable. Research on creativity began in earnest with the work of J. P. Guilford and E. Paul Torrance, who defined and measured creativity in terms of divergent thinking: a person's ability to provide multiple, original, and unique solutions to a problem. The Torrance Tests of Creative Thinking, developed to measure individual creativity, are still widely used (Sternberg, 2006). The American Psychological Association (APA, 2023) defines creativity as an individual's ability to develop or produce original thoughts, work, theories, techniques, and unique imagination, and notes that the reasons why some people are more creative than others remain poorly understood.

Openness to Experience

Openness to experience is a broad personality dimension that captures the active pursuit of new experiences, intellectual curiosity, aesthetic sensitivity, and reflective engagement with ideas. Open individuals actively seek out varied knowledge and experience instead of being passive recipients of information (McCrae & Costa, 1997; McCrae & Greenberg, 2014). Within the Big Five framework, openness is often differentiated into facets, for example intellectual curiosity versus aesthetic appreciation and these facets can relate differently to outcomes of interest (Jach & Smillie, 2019; Kaufman et al., 2016).

Tolerance of Ambiguity

The idea of tolerance of ambiguity emerged in the study of personality and perception from the late 1940s onward (Budner, 1962; Frenkel-Brunswik, 1949). TOA involves perceiving ambiguous situations as desirable or at least manageable, whereas a person with low TOA perceives ambiguous situations as threatening and undesirable. Later scholars have treated TOA as an individual difference that influences beliefs, motivation, values, and behavior, and that shapes whether people approach or avoid ambiguous stimuli (Furnham & Ribchester, 1995; Stoycheva, 2003). However, the dimensionality of the construct and the quality of its measures are still under debate (Furnham & Marks, 2013). Self-report scales such as those of Budner (1962), MacDonald (1970), and Norton (1975) most often assess TOA. Some authors have also developed behavioral scales (Stoycheva, 2003) and behavioral choice tasks (Jach & Smillie, 2019). The heterogeneity of instruments, and the weak convergence between self-report and behavioral measures in at least some studies (Jach & Smillie, 2019), should temper confidence in any single finding.

II. METHOD

Review Design

This paper is a narrative review rather than a systematic review. It did not follow a pre-registered search protocol, and no formal risk-of-bias or quality appraisal was applied to the included sources. Both empirical studies and theoretical or conceptual works were considered, because the aim was to connect evidence with explanation.

Sources and Selection

Sources were chosen for (a) conceptual relevance to openness to experience, tolerance of ambiguity or creativity; (b) influence in the field as measured by role in defining or measuring constructs and (c) where possible use of student or young-adult samples.

Procedure

The evidence was synthesized narratively and organized around the three pairwise associations (OE–creativity, TOA–creativity and OE–TOA) and mediation. Participant characteristics, measures and designs are reported and selected empirical studies are summarized in Table 1.

III. RESULTS

Openness to Experience and Creativity

Openness is the dimension of Big Five that is most consistently associated with creativity. In pioneering studies, McCrae (1987) found that divergent-thinking scores were associated with openness to experience but not reliably with the other four personality factors, and that both divergent thinking and openness correlated with a measure of creative personality. A later meta-analytic synthesis of personality in scientific and artistic creativity likewise highlighted traits related to openness (Feist, 1998). Work separating openness into its components shows that the picture is nuanced: openness and intellect appear to predict creative achievement differently in the arts and sciences (Kaufman et al., 2016). Studies of young adults also tie personality to creative performance and to creative activities such as story writing and hobbies (Wolfradt & Pretz, 2001). Process-oriented research offers further explanation. Tan et al. (2019) examined intrinsic motivation and engagement in the creative process as mediators of the relation between openness and creativity, suggesting that openness may operate through motivational and behavioral routes rather than only directly. This is notable for the present review because it demonstrates that mediation accounts of the openness–creativity link already exist, even if TOA has not been the mediator of focus.

Tolerance of Ambiguity and Creativity

Generating something unique requires staying with incomplete information long enough for a novel solution to emerge, rather than closing prematurely on a familiar answer (Zenasni et al., 2008). Creativity theorists have therefore argued that TOA matters for creative work. Despite the strength of these theoretical claims, direct empirical tests have been comparatively few (Zenasni et al., 2008). The most cited empirical contribution is by Zenasni et al. (2008), who studied parents and their adolescent children using three creativity measures (a divergent-thinking task, a story-writing task, and self-evaluation of creative attitudes and behavior) and two self-report TOA measures. TOA was significantly and positively related to creativity. Parents' creativity was related to their adolescent children's creativity, but parents' TOA was not related to their children's TOA or creativity, a pattern that argues against a simple family-transmission account. Earlier work by Tegano (1990) also reported a relationship between TOA and creative behavior (see Zenasni et al., 2008).

Research on student samples has broadly found similar relationships. Stoycheva (2008) found that TOA was positively related to creative motivation in samples of high school students ($n = 106$) and university students ($n = 135$), but not need for achievement - so TOA is not just a measure of general achievement orientation. Balgiu (2014) looked at ambiguity tolerance with respect to creative production tasks among students while Merrotsy (2013) revisited whether TOA should be considered a defining trait of the creative personality. Taken together these studies are suggestive but small numbers, often self-report instruments, different measures and in several cases closely connected research groups so the evidence base for the TOA–creativity link is best described as promising but not yet robust.

Openness and Tolerance of Ambiguity

The two are related but not interchangeable. Jach and Smillie (2019) tested whether TOA reflects personality traits based on fear of the unknown (neuroticism) or attraction to it (openness and extraversion). For self-report measures results showed both patterns; openness predicted TOA even after controlling for intelligence. A network

analysis indicated that TOA was more strongly connected to the intellectual curiosity facet of openness than to the aesthetic appreciation facet and, within extraversion, to assertiveness rather than energy or sociability. The authors interpreted these results as consistent with theories that describe personality in terms of how people manage uncertainty (see Hirsh et al., 2012, on psychological entropy). Importantly, behavioral choice measures of ambiguity tolerance in that study showed poor reliability and were unrelated to self-reported tolerance or to personality, which is a reminder that conclusions rest largely on self-report. Bardi et al. (2009) provide evidence for the distinctness of the constructs. In the context of a transition into university life, openness and ambiguity intolerance related differently to well-being, even though earlier writers had suggested that ambiguity intolerance is part of openness. This matters conceptually: if TOA were simply a facet of openness, it could not meaningfully serve as a separate explanatory variable between openness and an outcome.

Summary of Selected Studies

Table 1 summarizes the design, constructs, and main findings of the empirical studies discussed above.

Table 1: Summary of Selected Studies on Openness, Tolerance of Ambiguity, and Creativity

Study	Research design	Constructs	Main findings
McCrae (1987)	Adult samples; correlational	Openness, divergent thinking, creative personality	Divergent thinking related to openness more consistently than to the other Big Five factors
Zenasni et al. (2008)	Parents and adolescent children; correlational	TOA, three creativity measures	TOA positively related to creativity; parents' creativity related to children's creativity, but parents' TOA unrelated to children's TOA or creativity
Stoycheva (2008)	106 high school and 135 university students; correlational	TOA, creative motivation, need for achievement	TOA positively related to creative motivation, unrelated to need for achievement
Bardi et al. (2009)	University students in a life transition	Openness, ambiguity intolerance, well-being	The two traits related differently to well-being, supporting their distinctness
Jach & Smillie (2019)	Self-report and behavioral tasks; network analysis	TOA, Big Five	Openness (especially intellectual curiosity) predicted self-reported TOA; behavioral measures showed poor reliability and were unrelated to self-reported TOA or personality
Tan et al. (2019)	Correlational; mediation	Openness, intrinsic motivation, creative process engagement, creativity	Openness related to creativity via motivational and process-engagement pathways

Note. TOA = tolerance of ambiguity

Does TOA Mediate the Link Between Openness and Creativity?

If openness pushes people toward novelty and TOA is related to both openness and creativity then TOA could plausibly be a mediator. However, among the studies reviewed here, no direct statistical tests of TOA as a mediator of the openness–creativity relation were found. The available evidence is therefore correlational, and the mediation hypothesis is best treated as theoretically motivated and empirically open.

IV. DISCUSSION

This review set out to clarify how OE, TOA, and creativity are related, and whether TOA may help explain how openness is translated into creative outcomes. Three conclusions emerge. First, OE is the most consistently supported personality correlate of creativity (Feist, 1998; McCrae, 1987), although facets of OE may relate differently to creative achievement in different domains (Kaufman et al., 2016). Second, TOA is positively related to creativity and creative motivation (Stoycheva, 2008; Zenasni et al., 2008) but evidence base is small (self-report), concentrated in few research groups and only indirectly related. Third, OE and TOA are related but not the same thing (Bardi et al., 2009; Jach & Smillie, 2019); so the possibility exists that TOA has a separate explanatory role. No study reviewed here tested it directly.

Theoretical Perspectives

The Systems Model of Creativity

Csikszentmihalyi's (1999) systems model states that creativity is the result of three elements: individual (the personality and cognitive attributes of a person), domain (knowledge and rules of the problem field) and field (gatekeepers who judge and select novel contributions). For undergraduate research this means that OE and TOA dispositions operate in academic settings and sociocultural contexts. These contexts and cultures might affect the influence of OE and TOA on creativity. Context variables should therefore be studied in future work.

The Experiential Subtheory of Intelligence

Sternberg's (1985) triarchic theory differentiates analytical, creative, and practical aspects of intelligence. Its experiential subtheory is the most relevant here: it states that intelligence is best demonstrated at the two ends of a continuum of experience, namely when a person faces a novel task or situation and must devise a way of handling it, and when a familiar task has become automatic and can be carried out with minimal thought. The novel end of this continuum is almost by definition ambiguous. Success there plausibly requires both seeking out and engaging with novelty (openness) and managing the uncertainty that novelty brings (tolerance of ambiguity).

Uncertainty-Management Accounts of Personality

Psychological entropy accounts describe personality traits in terms of how people respond to uncertainty and the anxiety it can cause (Hirsh et al., 2012). Traits that reduce anxiety about uncertainty or increase attraction to the unknown should support behavior that involves staying with unresolved situations — which is central to creative problem solving. The associations reported by Jach and Smillie (2019) are consistent with this approach but correlational evidence only.

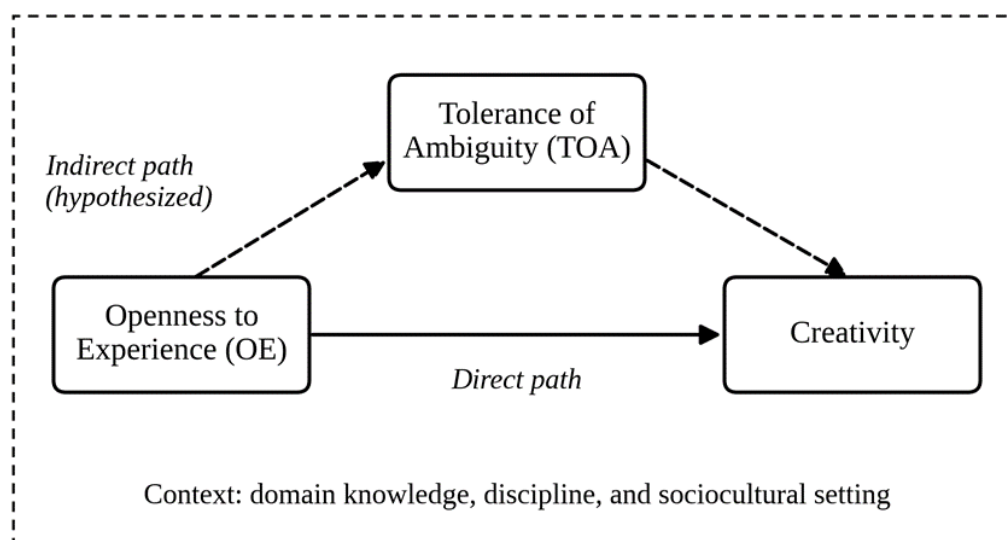
A Heuristic Two-Process Interpretation

To put the above together, this review provides a heuristic interpretation not an established theory: one process (approach-oriented and exploratory) is open (i.e. motivation to seek out new ideas and experiences); another process (regulatory) is TOA (i.e. toleration of discomfort caused by unclear or unfinished work so that person continues to explore rather than disengage or close prematurely). Creativity may be most likely when both are present. This interpretation is consistent with accounts emphasizing anxiety reduction (Zenasni et al., 2008) and broadened cognitive exploration but the division of labor between the two processes has not been directly tested so it should be treated as hypothesis.

An Integrative Conceptual Model

The model projected here is shown in Figure 1 and has three components.

Figure 1: Proposed Integrative Model of Openness to Experience, Tolerance of Ambiguity, and Creativity



OE → Creativity (direct path). Openness is associated with creativity through curiosity, a broad base of knowledge and experience, and intrinsic motivation (McCrae, 1987; Tan et al., 2019).

OE → TOA → Creativity (indirect path). Openness is related to higher TOA (Jach & Smillie, 2019), and higher TOA is related to creativity and creative motivation (Stoycheva, 2008; Zenasni et al., 2008). TOA may thus carry part of openness's effect on creativity by allowing persistence under uncertainty.

Contextual influences. Knowledge of the domain, discipline and sociocultural context (Csikszentmihalyi, 1999) are expected to influence both how these traits are expressed and what outcomes are considered creative.

From this model follow three propositions that future empirical work could test:

- P1. TOA is positively associated with creativity among undergraduates.
- P2. OE is positively associated with creativity among undergraduates.
- P3. TOA partially mediates the relation between OE and creativity, with the strength of the indirect effect depending on how creativity is operationalized and on the academic domain.

Implications for Education

If TOA is a driver of creative functioning, then teaching approaches that expose students to open-ended ill-structured problems and normalize discomfort at not having an immediate answer might help them develop the disposition - project based learning, design studios and assessments that value exploration over single correct answers. From a positive-psychology perspective, these approaches treat curiosity and comfort with uncertainty as strengths to be cultivated rather than deficits to be remedied. These suggestions are theoretically motivated; the intervention evidence needed to show that TOA can be changed, and that changing it improves creativity, is still lacking. Educators should also be mindful that students with low TOA may experience open-ended tasks as stressful, so scaffolding and gradual increases in ambiguity may be useful.

Limitations and Methodological Issues

Limitations of the Present Review

As a narrative review with purposive source selection and no formal quality appraisal, this review cannot claim to be exhaustive, and its conclusions may be influenced by which sources were chosen. Its conclusions should be read as an organized interpretation of the literature available rather than a quantitative estimate of effect sizes.

Reliance on Self-Report

Nearly all of the evidence on TOA comes from self-report scales, and behavioral measures have so far shown limited reliability (Jach & Smillie, 2019). Shared method variance can inflate associations among personality and creativity self-ratings.

Heterogeneous Measures of Creativity

Divergent thinking, creative achievement, self-rated creativity, and product ratings capture different things (Batey & Furnham, 2006). Creative-achievement questionnaires (e.g., Carson et al., 2005) record accomplishments, which many undergraduates have had little time to accumulate, so scores may be low and skewed in student samples. Performance-based tasks may be more informative for this group.

Measurement of Openness

Studies differ in whether they use full-length inventories, facet scales, or short forms. Openness facets can relate differently to creativity and to TOA (Jach & Smillie, 2019; Kaufman et al., 2016), so analyses at the facet level are preferable to a single global score where sample size permits. Researchers should also report the exact instrument and number of items; for example, the NEO PI-R (Costa & McCrae, 1992) measures openness through six facets with a large item pool rather than a single short subscale.

Construct Overlap

Since TOA and openness are correlated, we need discriminant validity (Bardi et al., 2009) before treating TOA as a separate mediating mechanism.

Cross-Sectional Designs

Mediation inferred from one-time correlational data cannot establish temporal order or causation. Reverse and reciprocal relations are conceivable too: creative experiences might increase tolerance for ambiguity, etc.

Limited Generalizability

Many studies use convenience samples of students at a single institution, and the literature draws disproportionately on a handful of national and research contexts. The question of whether findings apply across cultures (e.g., South Asian and East Asian higher education) is not considered in the sources reviewed here at all.

Quality of the Evidence Base

TOA–creativity studies are few, small and often from connected research groups. One of the student-sample findings above (Stoycheva, 2008) is not available to this review as a conference abstract. Publication bias cannot be ruled out.

Future Research Directions

- Test the mediation model directly (with sufficiently powered samples, validated multi-item measures and analyses [bootstrapped indirect effects or structural equation modeling] reporting effect sizes and confidence intervals)
- Use multi-method assessment (self-report with performance tasks like divergent thinking tests and rated creative products; behavioral indices of ambiguity tolerance where possible but reliable).
- Use longitudinal and experimental designs (studies where students are followed over the years in university, interventions manipulating exposure to ambiguous tasks).
- Look at moderators (academic discipline, prior domain knowledge, educational and cultural context) (Csikszentmihalyi, 1999).
- Study facets not only global traits (e.g., intellectual curiosity vs aesthetic appreciation within openness) (Jach & Smillie, 2019).
- Repeat across cultures and institutions (Pakistani and other South Asian undergraduate populations as well as Chinese undergraduate populations) to see if the relationships reported in the literature generalize.

V. CONCLUSION

Openness to experience is a well-established correlate of creativity and tolerance of ambiguity is theoretically compelling and empirically plausible but less so. OE and TOA are related but distinct (existing studies); TOA is positively associated with creativity and creative motivation but whether TOA explains how openness translates into creative outcomes (especially among undergraduates) has not been tested. A program of well powered multi method longitudinal studies attentive to measurement and context would answer this question and show if the model presented here holds true and if tolerance of ambiguity is a target for educational efforts to foster creativity.

Ethical Approval and Informed Consent

This article is a narrative review of previously published literature. There were no human participants or primary data collection so ethical approval and informed consent were not needed.

Conflicts of Interest

The author(s) declare no potential conflicts of interest.

Author Agreement

The author(s) certify that this work is original, has not been published elsewhere and is not under consideration elsewhere.

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