

Creativity and Ambiguity Tolerance

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Abstract: *We provide experimental evidence on whether engaging in a creative task affects the degree to which one tolerates ambiguity. We find that subjects who completed a creative task invest significantly more in a lottery with unknown odds than subjects involved in a non-creative task, suggesting that being exposed to creativity may engender higher openness to ambiguity and novelty.*

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1. Introduction

Ambiguity – or uncertainty about probabilities – is a ubiquitous phenomenon, affecting how people assess the value of available options either in individual or social contexts. The effect of ambiguity on choice has attracted scholarly attention since Ellsberg (1961). Individuals tend to exhibit aversion to ambiguity, preferring a lottery with known odds to another where the probability of success is unknown, to the point of paying to “indulge preferences for less ambiguity” (Charness and Gneezy, 2010, p. 133). Nonetheless, being able to deal with ambiguous situations has important implications for learning, intrapersonal behavior, and decision-making (Spinelli et al., 2022). Prompting people to be more open to ambiguous situations could improve their individual cognitive and affective well-being (Park et al., 2020), openness to diversity (Geller et al., 2021), and willingness to engage in pro-social activities (Vives and FeldmanHall, 2018).

Unlike performance in standard endeavors, creative ideas deviate from established paths, and may not deliver the desired outcome. Ambiguity tolerance has been associated with improved ability to manage novel, complex, and insoluble situations (Furnham and Marks, 2013). Given that novel ideas imply more ambiguity over possible outcomes and success, ambiguity-tolerant people are more likely to select creative ideas (McLain, 2009). Yet while the literature thus suggests a positive relation between ambiguity tolerance and creativity, the causal nexus has not yet been investigated. Are there effects on ambiguity attitudes from exposing people to creative tasks or environments? This research question may shed light on how the type of activity in which we engage may affect how we think and make decisions.

2. Material and methods

We present the results of a laboratory experiment where subjects complete either a creative or a non-creative, standardized real-effort task. There were 27 pen-and-paper sessions, with a total amount of 400 participants. The experimental sessions were conducted at the University of California, Santa Barbara. Subjects knew nothing about the type of task they would be completing, so no self-selection could occur. Part of the data have already been used in Charness and Grieco (2021)’s paper on creativity and corporate culture, which investigates the effects on corporate values and creative score of receiving individual vs. group incentives.

In the creative treatment, we used three types of creative questions: verbal, math, and drawing. Participants in groups of three had 25 minutes to answer a specific question of this set of three questions:

1. *“Choose a combination of words to write a creative story.” The words supplied were: house, zero, forgive, curve, relevance, cow, tree, planet, ring, send. Participants were told that they must use these words along with any other combination of words that they wished. (verbal)*
2. *“Starting from the number 27, obtain the number 6 in the most creative way you can by using at least two different numerical operations.” Participants were told that they must use these numbers along with any other combination of numbers that they wished. (math)*
3. *“Draw a creative picture using the following shapes [a figure presenting a set of shapes follows]”. Participants were told that they must use these shapes along with any other combination of shapes that they wished. (drawing)*

In the non-creative treatment, the instructions and the procedure were identical to the ones used for creative tasks, thereby isolating the effect of the type of task. Participants answered a specific question out of these three:

1. *“You receive ten sets of 30 words. For each set, you have to put words in alphabetical order. Answers will be evaluated as correct if all the words in each set are put in the correct order.” (verbal)*
2. *“You receive ten pages containing 0’s and 1’s. For each page, you have to count the amount of 0’s and write it in the box at the end of each page. Answers will be evaluated as correct if the number you write corresponds to the exact number of 0’s in the page.” (math)*
3. *“You receive ten blank pages. For each blank page, you have to draw the amount of shapes asked on top of the page using a geometry template and fill them in with the indicated color. Answers will be evaluated as correct if all the shapes in each set are completely drawn and colored.” (drawing)*

After completing the task, subjects answered a post-experimental questionnaire where, among the other questions, subjects had to decide the amounts to invest in a risky and in an ambiguous lottery. In each lottery, one is endowed with 100 units and could invest any portion in a risky asset with a 50 percent chance of success. The investment paid 2.5 times the amount invested if successful and nothing if unsuccessful, while the individual retained whatever units were not invested. This procedure provides a measure of risk tolerance: the higher the investment, the more risk-tolerant is the individual. The question on ambiguity attitude is identical except that we did not state the probability that the investment would be successful. Participants were made aware that one participant will be selected at random for the risky lottery, and another one will be selected for the ambiguous lottery: in both cases, the investment decisions for those participants selected have monetary consequences on their payoffs.

The questionnaire also included 10 questions on creative and cognitive style and sensation-seeking attitude, as well as seven questions on demographic features, plus other six questions on past involvement in creative activities.

3. Results and discussion

The average investment in the ambiguity lottery is significantly higher in the creative treatment (53.22 vs. 40.29, Wilcoxon rank-sum test, with $Z = -3.901$, $p < 0.001$). Table 1 reports a set of OLS regressions exploring the determinants of the amount invested. The results confirm the findings from our non-parametric tests.

Table 1. Determinants of ambiguity tolerance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Creativity	12.933*** [3.094]	16.192*** [2.400]	16.267*** [2.500]	18.617*** [6.757]	15.179** [6.636]	24.391*** [7.234]	19.074** [7.806]
Risk tolerance		0.546*** [0.052]	0.542*** [0.052]	0.544*** [0.053]	0.566*** [0.052]	0.597*** [0.051]	0.626*** [0.053]
Score			0.066 [0.563]	0.157 [0.647]	0.065 [0.661]	0.181 [0.674]	-0.041 [0.713]
Score*creativity				-0.479 [1.354]	0.633 [1.338]	1.730 [1.329]	1.735 [1.348]
Incentives					-10.563*** [2.975]	-4.918* [2.416]	-7.411** [3.600]
Group_incentives					-0.535 [2.774]	4.576 [3.882]	4.681 [4.524]
Incentives*creativity						-16.241*** [5.772]	-11.134* [6.647]
Group_incentives*creativity						-8.561 [5.320]	-9.338 [5.728]
Creative_style							0.156 [1.135]
Sensation_seeking							2.438 [1.726]
Male							-6.688** [2.681]
Age							0.539 [0.340]
Sum_art							0.872 [0.937]
Constant	40.288*** [2.258]	5.636* [3.119]	5.517 [4.676]	4.899 [5.258]	10.717* [5.726]	3.506 [5.996]	-10.992 [11.287]
Observations	383	370	368	368	368	368	357
R-squared	0.044	0.327	0.324	0.324	0.347	0.368	0.393

OLS (standard errors in parentheses, clustered at the group level). The dependent variable assumes values 0-100. *Creativity* is a dummy variable assuming value 1 when the subject engages in the creative task and 0 elsewhere. *Risk_tolerance* is the number of tokens (0-100) the subjects has invested in the risky lottery. *Score* is the performance (0-10) in the task. *Score*creativity* is the interacted variable between the dummy variables *Creativity* and *Score*. *Incentives* is a dummy variable assuming value 1 when payment is output-related and 0 elsewhere. *Group_incentives* is a dummy variable assuming value 1 when the payment is group-based and 0 when individual-based. *Incentives*creativity* is the interacted variable between the dummy variables *Incentives* and *Creativity*. *Group_incentives*creativity* is the interacted variable between the dummy variables *Group_incentives* and *Creativity*. *Creative style* is a variable from 0 (conceptual style) to 7 (experimental style). *Sensation_seeking* captures the preferences for the new and unfamiliar as opposed to the familiar. *Sum_art* captures the range (0-7) of artistic endeavors the subject has performed in the past. Other controls (unreported because non-significant): major, number of siblings, parents' marital status, birth order, right-handed. *** significant at 1%; ** significant at 5%; * significant at 10%.

Column 1 shows that being exposed to creativity has a highly-significant positive effect on ambiguity tolerance. Ambiguity tolerance is also significantly and positively associated to risk tolerance, as seen in columns 2-7. We try to shed light on the mechanism in Columns 3-6. We first check whether the subject's score - as a proxy for performance - has an impact on ambiguity tolerance. Columns 3-4 show that one's creative score generally plays no role, and there is no relevant interaction between the score and the type of task. In columns 5-6, we test whether incentives (i.e., being paid for performance) matter: the regression results confirm that individual (but not group) incentives determine a lower investment with ambiguity, stronger for creative tasks. Subjects may choose a hedging strategy and invest more in the ambiguous lottery when their earnings from the task are "safe" (i.e., flat), especially with creative tasks whose outcome is more uncertain.

An alternative interpretation is that intrinsic motivation (i.e., the pleasure of engaging in the task *per se*) has a positive mediating effect, occurring especially in case of creative tasks. While, to our knowledge, there is no evidence of the mediating effect of joy or satisfaction, some studies on ambiguity aversion find a mediating effect for sadness or stress. Kibris and Uler (2021) found that subjects with traumatic experiences of armed violence report greater sadness, which in turn partially predicts their risk and ambiguity aversion. Similarly, Raio et al. (2022) show that greater stressor exposure is associated to higher ambiguity-aversion.

Finally, column 7 shows that our results hold with socio-demographic controls.¹

4. Conclusions

We show that the exposure to a creative task appears to have a causal effect on ambiguity tolerance. This relation is stronger in the absence of monetary incentives, thus allowing for hedging and/or a mediating effect of the intrinsic pleasure of engaging in creativity. Our results suggest that having

¹ One caveat we would like to mention is that we did not have an *ex-ante* hypothesis on this issue, as it simply had not occurred to us to test it. But this does seem like a natural prediction.

one engage in creative tasks and thereby be more open to ambiguity could possibly improve one's cognitive and affective well-being, openness to diversity, and willingness to engage in pro-social activities. More research is needed on this embryonic topic.

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