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Exploring the underpinnings of impaired strategic decision-making under stress

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ABSTRACT

The present study sought to examine the underpinnings of impaired strategic decision-making under stress. In contrast to previous laboratory-based research, we conducted a quasi-experiment in a real life stress situation. Specifically, we used the beauty contest game and compared the performance of a group of participants who were exposed to a real-life stressor (waiting to attend an exam at a university class) with a control group of participants who were not exposed to stress (waiting to attend a regular lecture at a university class). Furthermore, about half of the participants were instructed to write down what they believed another participant had assumed the average number in the beauty contest game to be and which target number she (or he) had chosen accordingly. The results showed that stress impaired strategic reasoning in the beauty contest game. Importantly, even when only including participants who understood the rules of the game in the analyses, stress still increased the numbers chosen in the beauty contest. Furthermore, we found that participants in the stress condition were significantly less likely to base their chosen number on their belief about other players' choices. Hence, stress not only impairs understanding of the math behind the beauty contest game but also the degree of strategizing per se.

1. Introduction

Often, important economic decisions have to be made under stress, for example, financial decisions on the stock market or managerial decisions. Excessive job demands are assumed to influence strategic decision-making (Hambrick, Finkelstein, & Mooney, 2005) and stress is proposed as the mediating process (Ganster, 2005). Stress negatively affects information processing and triggers well-learned or dominant responses affecting individual and organizational behavior (Staw, Sandelands, & Dutton, 1981). Stress has been found to be associated with a narrowing of perception and a reduction of sensitivity to others (Cohen, 1980) which in a team task may be associated with lower performance due to an impairment of the team perspective (Driskell, Salas, & Johnston, 1999). However, we know very little about the effect of stress on strategic decision-making.

Experimental studies show that diverse facets of decision-making are affected by stress. In situations where risk avoidance, deliberate information processing and the use of higher order cognition are required, acute stress has been found to alter decision-making processes in several ways (for a review see Starcke & Brand, 2012). For example, it was found that

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in risky choices framed as gains, acute stress led to risk seeking, whereas in risky choices in the loss domain, stress led to risk aversion (Porcelli & Delgado, 2009), which is a reversal of the pattern found in studies with non-stressed participants (e.g., Battalio, Kagel, & Jiranyakul, 1990; Camerer, 1989) and violates prospect theory (Kahneman & Tversky, 1979). Furthermore, stressed individuals have been found to consider less options and make quicker choices (Chajut & Algom, 2003; Keinan, 1987), are less likely to consider possible contingencies (Johnston, Driskell, & Salas, 1997), take longer to learn cost-benefit associations of choice options (Preston, Buchanan, Stansfield, & Bechara, 2007), and insufficiently adjust from automatic responses (Kassam, Koslov, & Mendes, 2009; Porcelli & Delgado, 2009).

However, previous research investigating the effect of stress on decision-making has almost completely neglected strategic decisions (for an exception, see Leder, Häusser, & Mojzisch, 2013). This is surprising given that strategizing (e.g., thinking about what other actors affecting ones' outcomes might think) is a crucial aspect of successful economic decision-making. For example, asset prices are less affected by the fundamental value of the asset but more by what people think everyone else thinks the asset value is (Shiller, 2005). We therefore sought to further examine the impact of stress on strategic decision-making.

1.1. Strategic decision-making and the beauty contest game

Strategic interactions are often examined in the context of game theory. It is argued that an important mechanism underlying strategic choices is the reasoning about others' choices (Ho & Camerer, 1998; Nagel, 1995). In his classic work, "The General Theory of Unemployment", Keynes (1936, p. 156) argued that "... professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preferences of the competitors as a whole; so that each competitor has to pick not those faces which he himself finds prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at the problem from the same point of view. It is not a case of choosing those which, to the best of one's judgment, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligence to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees".

Starting with the seminal paper of Nagel (1995), recent research in the area of behavioral economics and economic psychology employs the beauty contest game to examine strategic reasoning. In the beauty contest game, a number of players simultaneously choose a number x_i in the interval [0,100]. The average of all the numbers chosen by the players is calculated and multiplied by a multiple $p < 1$ (e.g., $p = 2/3$, which is typically used). The player whose number is closest to that target number (i.e., 2/3 of the average) wins the game and receives a monetary prize (Ho & Camerer, 1998; Nagel, 1995). The player's behavior (i.e., which number he or she chooses) can be conceived of as the result of iterated steps of reasoning about other players' choices (for a summary see Bosch-Doménech, Montalvo, Nagel, & Satorra, 2010). For example, given a beauty contest game with $p = 2/3$, if a player assumes that every other player responds with a random number, he or she should respond with 33.33 (since 50 is the average of randomly chosen numbers from 0 to 100, and multiplying 50 with 2/3 leads to 33.33). If a player expects that all other players will figure this out, then he or she should choose a number close to 22.22. With increasing iterations, the number chosen will converge toward zero (i.e., the Nash equilibrium). However, choosing zero in the beauty contest game is highly unlikely to lead to winning, since other actors are not fully rational. As a result, zero being 2/3 of the mean is highly unlikely.

It is inherent in the idea of iterated steps of reasoning that not only strategic reasoning ability but the belief a decision maker holds about the level of sophistication of the other players influences the numbers chosen (Nagel, 1995; Stahl & Wilson, 1995). For example, it has been shown that when beliefs are manipulated directly by playing with either computers that are said to act randomly or with a group of other graduate students, chosen numbers are adjusted depending on the type of other players and are also sensitive to changes in the group composition (i.e., the number of computer and human players in a group) (Agranov, Potamites, Schotter, & Tergiman, 2012).

To the best of our knowledge, only one study so far has investigated the effect of stress on strategic decision-making (Leder et al., 2013). In this study, stress was manipulated using the group version of the Trier Social Stress Test (TSST-G; von Dawans, Kirschbaum, & Heinrichs, 2011). The TSST is a widely used experimental protocol to induce stress in the laboratory consisting of a mock job interview and mental arithmetic (Kirschbaum, Pirke, & Hellhammer, 1993; Kudielka, Hellhammer, & Kirschbaum, 2007). Strategic decision-making was measured with the beauty contest game (Nagel, 1995). The results revealed that participants under stress chose significantly higher numbers in the beauty contest game than non-stressed participants, hence suggesting that stress impairs strategic decision-making.

Although higher numbers in the beauty contest game are typically interpreted to reflect lower degrees of strategizing (e.g., Nagel, 1995), two alternative explanations are conceivable[1]: (1) higher numbers would also result if players simply failed to understand the mathematical mechanism underlying the beauty contest game (i.e., the logical relationship between the mean of chosen numbers as a multiple of the factor p and the target number). For example, a player who fails to understand the mechanism might simply pick the number 50 (assuming that picking the average number might be a good choice, minimizing the distance to all possible numbers). (2) Higher numbers would also result if players would assume lower levels of

[1] We are grateful to an anonymous reviewer for pointing out the second explanation.