Revista de Administração Contemporânea
Journal of Contemporary Administration

ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO E PESQUISA EM ADMINISTRAÇÃO

e-ISSN: 1982-7849

Theoretical-empirical Article

Decision-Making under Stress: The Hiding behind a Small Cake Effect

Tomada de Decisão sob Estresse: O Efeito "Esconder-se atrás de um Bolo Pequeno"

Erika Mirian Nogas[1]
Angela Cristiane Santos Póvoa*[1]
Wesley Pech[2]

ABSTRACT

Objective: we analyzed decision-making under stress by manipulating salivary cortisol levels. **Theoretical background:** literature dedicated to the relationship between stress and decision-making is still inconclusive. Studies have found that when dealing with stressful decisions, people will respond with a greater propensity for opportunistic behavior. However, stress might also decrease the potential for deception when the decision requires strategic/analytical responses. **Method:** we implemented a laboratory experiment using the ultimatum game with asymmetric information, in which only the first mover was fully informed about the size of the endowment. Our experiment compared the decisions of subjects who received a stress stimulus from an adapted Trier social stress test for groups (TSST-G) protocol with a control group. **Results:** we found that under stress, proposers transferred more to responders. In contrast, non-stressed players were more likely to take advantage of information asymmetry by choosing lower strategic offers, which is consistent with the so-called 'hide behind a small cake' effect. Regression analysis also indicated that larger offers are not necessarily associated with increased prosocial motives since stressed proposers became more confident about the responder's ability to guess the true endowment, which decreased their incentive to take advantage of the aforementioned effect. **Conclusions:** one possible effect of stress could be an increase in risk perception, decreasing the ability to make strategic decisions. The stressful condition might have rendered our participants less capable of realizing the 'hide behind a small cake' potential of the game, leading them to make more conservative offers when compared to the control group.

Keywords: decision-making; asymmetric information; stress; ultimatum game.

RESUMO

Objetivo: analisamos a tomada de decisão sob estresse, manipulando os níveis de cortisol salivar. **Marco teórico:** a literatura dedicada à relação entre estresse e tomada de decisão ainda é inconclusiva. Estudos sugerem que, ao lidar com decisões estressantes, as pessoas respondem com maior propensão ao comportamento oportunista. No entanto, o estresse também pode diminuir o potencial de engano quando a decisão requer respostas estratégicas/analíticas. **Método:** implementamos um experimento de laboratório utilizando o jogo do ultimato com informação assimétrica, no qual apenas o primeiro jogador tinha informação completa. Nosso experimento comparou as decisões de sujeitos que receberam um estímulo de estresse de um protocolo adaptado do 'Trier social stress test for groups' (TSST-G) com um grupo controle. **Resultados:** foi observado que, sob estresse, os jogadores proponentes transferiam mais para os respondentes. Em contraste, os jogadores não estressados eram mais propensos a tirar proveito da assimetria de informação, escolhendo ofertas estrategicamente mais baixas, o que é consistente com o chamado efeito "esconder-se atrás de um bolo pequeno". A análise de regressão também indicou que ofertas maiores no jogo não estavam necessariamente associadas a motivos pró-sociais mais elevados, uma vez que os proponentes estressados tornaram-se mais confiantes sobre a capacidade do respondente de adivinhar a verdadeira dotação, o que diminuiu seu incentivo para aproveitar o efeito investigado. **Conclusões:** Um possível efeito do estresse pode ser o aumento na percepção de risco, diminuindo a capacidade de tomar decisões estratégicas. O tratamento na condição de estresse pode ter tornado nossos participantes menos capazes de perceberem o potencial de ganho por meio do efeito "esconder-se atrás de um bolo pequeno", levando-os a proporem ofertas mais conservadoras quando comparadas as ofertas do grupo de controle.

Palavras-chave: tomada de decisão; informação assimétrica; estresse; jogo de ultimato.

* Corresponding Author.
1. Pontifícia Universidade Católica do Paraná, Curitiba, PR, Brazil.
2. Tennessee Tech University, Cookeville, Tennessee, USA.

Cite as: Nogas, E. M., Póvoa, A. C. S., & Pech, W. (2023). Decision-making under stress: The hiding behind a small cake effect. *Revista de Administração Contemporânea*, 27(6), e230023. https://doi.org/10.1590/1982-7849rac2023230023.en

Published to this issue: December 11, 2023.

JEL Code: D91.

Editor-in-chief: Marcelo de Souza Bispo (Universidade Federal da Paraíba, PPGA, Brazil)
Associate Editor: Evelyn Lanka (Cranfield University, United Kingdom)
Reviewers: Meg Kiseleva (Cardiff University, United Kingdom)
The other reviewer did not authorize the disclosure of his/her identity.
Peer Review Report: The Peer Review Report is available at this external URL.

Received: February 14, 2023
Last version received: September 30, 2023
Accepted: October 21, 2023

# of invited reviewers until the decision:

	1	2	3	4	5	6	7	8	9	10
1st round	X	X	X	X	X	X	✓	X	X	✓
2nd round	✓	✓								

INTRODUCTION

Stress can change many different aspects of decision-making, some advantageous to the individual and organizations, some disadvantageous, and it can also affect cognitive and emotional processes with repercussions to the decision-maker's health and organizational outcomes (Starcke et al., 2017). Psychologists' most frequent definition of stress is a real or perceived imbalance between environmental demands required for survival and an individual's capacity to adapt to these requirements (Keefer et al., 2008).

Some common effects of stress on the decision-making process, according to the literature, are increases in risk-taking and anxiety often leading to risk-averse choices (Hengen & Alpers, 2021; Porcelli & Delgado, 2017); increase in emotional or impulsive choices (Moustafa et al., 2017; Raio et al., 2020); focus on immediate problems neglecting the broader perspective (Keinan, 1987); and interference in the logical thinking and problem-solving abilities (Lupien et al., 2007; Starcke & Brand, 2012).

More specifically, studies have found that when dealing with stressful decisions, the decision-maker will respond to situations of irritation, cognitive strain, and stress with a greater propensity for opportunistic behavior (Appelbaum et al., 2007; Gneezy & Ariely, 2010; Henle, 2005; Henle et al., 2005; Jones & Boye, 1994) and deception (Gneezy, 2005; Mazar et al., 2008). Fox, Spector and Miles (2001) claimed that organizational injustice could itself be a work stressor, which is defined as a situation that elicits an adaptive response (Jex & Beehr, 1991, as quoted in Fox et al., 2001) or negative emotional reactions (Spector, 1998). Gneezy and Ariely (2010) found that experiencing a stressful situation could increase cheating.

Since deceptive decisions are closely related to asymmetric information settings (Chavanne & Ferreira, 2017; Kajackaite & Gneezy, 2017; Kriss et al., 2013), stress might have a causal effect on deceptive behavior. However, this conclusion may be hasty.

According to the literature, stress might also decrease the potential for deception when the decision requires strategic/analytical responses. Preston et al. (2007) found that stressed participants were slower in learning the proposed task, taking longer to shift toward advantageous decision-making. Stress manipulation has also been associated with increased blood pressure, reduced decision accuracy, and poorer performance in psychological games, with participants being slower in avoiding disadvantageous decisions (Simonovic et al., 2018). The potential for stress to affect cooperation or intuitive responses cannot be discarded either. Cappelletti, Güth, and Ploner (2011) found that players increased their transfers under time pressure in economics games and were more generous. Buchanan and Preston (2014) argued that stress has adverse effects on human behavior and can also lead to adaptive and altruistic behaviors in some circumstances. On the other hand, Bendahan et al. (2017) and Nickels et al. (2017) found that stress in experimental situations was responsible for some more selfish offers in an ultimatum game and that this was related to a 'flight or fight' response.

Yu (2016) argued that stress could lead to biased decisions because it causes a shift from analytical thinking to intuitive processes, which is associated with diminished activity in regions of the prefrontal executive control and areas of subcortical reactive emotion. According to these authors, based on the dual process theory[1], stressed individuals make more automatic heuristic judgments (Type 1) than contemplative ones (Type 2).

Thus, stress may lead to a greater tendency to follow intuitive responses that circumvent reasoning and lead to suboptimal final decisions.

Our study analyzed the effects of stress in a simple bargaining environment with asymmetric information. We adopted a modified version of the ultimatum game to examine the impact of stress in this context. The ultimatum game consists of two players: a proposer, who receives a monetary endowment, must choose first how to divide this amount between him and a second player, the responder. The dynamics of the game is described in the section on methodological procedures. We adopted a modified version of this game, where information regarding the initial endowment was revealed only to the proposer. The responder only received information about the probability distribution of possible endowments. The introduction of asymmetric information in the economic game adds an extra layer of strategic reasoning to the interaction between the players in the game, allowing the better-informed player to take advantage of that by making a selfish strategic offer, incurring in the 'hide behind a small cake effect'. This effect happens when better informed players take advantage of the privileged information to manipulate the other player's beliefs regarding the size of the endowment or the 'cake.' The cake could be either a small or large value, and when the respondent is uninformed about the real size of the cake, the proposer might offer exactly the equal split of the small cake to convey the idea that he/she received the smaller cake when, in fact, he/she received the biggest one. Thus, in this perspective, the proposer hides behind the smaller cake. Ockenfels and Werner (2012) explained that the underlying intuition behind this effect is that, with incomplete information about the cake size, the responder cannot be sure about the (un)fairness of a small offer, which the proposer might strategically exploit.

Thus, this study adopted the experiment based on economic games to evaluate the ability of our proposers to make strategic offers incurring in the 'hide behind a small cake' effect, which means manipulating the beliefs of the second player. We experimented with a control group and a treatment one, and the treatment group received a stressor manipulation using the adapted Trier social stress test for groups (TSST-G) protocol with salivary cortisol measurement before and after stimulus presentation. Thus, our study analyzed the effects of stress in a simple bargaining environment with asymmetric information.

Several studies have found that individuals are more likely to mislead each other by taking advantage of their informational advantage to send less than half of the endowment in economic games (Besancenot et al., 2013; Chavanne & Ferreira, 2017; Kriss et al., 2013; Vesely, 2014). However, these studies were conducted without stress manipulation, and since these economic games require some strategic/analytical responses, stress could potentially change the observed results.

The following sections of this paper have been thoughtfully structured to provide a clear understanding of the study's methodology. We begin by outlining the methodological procedures implemented in the research, including detailed information about the experimental setup. Moving forward, we delve into the statistical analyses conducted and present the corresponding results. Finally, we conclude by offering a few possible explanations for the results.

METHOD

The ultimatum game has been extensively used to investigate the importance of social preferences in strategic situations (Güth et al., 1982) it simulates a simplified take-it-or-leave-it bargaining environment and generally consists of two players: a proposer, who receives a monetary endowment, must choose first how to divide this amount between him and a second player, the responder. The responder observes the offer made by the proposer and chooses between accepting and rejecting the offer. If the offer is accepted, the division is implemented; if the responder rejects the offer, both players receive nothing.

In this study, we adopted a modified version of this game, with asymmetric information between players: the proposer received the information regarding the endowment in the game, while the responder only received information about the probability distribution of possible endowments. Specifically, there were three possible initial endowments (the experiment was conducted in Brazil, so the currency used for the experiment was the Brazilian real): R$10, R$20, or R$30. The proposer observed their endowment, but the responder did not. The responder was informed that there was a 50% probability that the proposer received R$10, a 25% probability that the proposer received R$20, and a 25% probability that the proposer received R$30. This probability distribution was common knowledge to all participants.

Thus, we chose the higher probability of a R$10 endowment to create more opportunities for the proposer to manipulate the responder's beliefs and increase their payoffs when the endowment was either R$20 or R$30. For example, consider a self-regarding proposer who received an endowment of R$30 and believes that the responder has preferences for equal payoffs. In this case, the proposer may have an incentive to offer only R$5 since the responder may have a significantly high degree of belief that the endowment is R$10 and the proposer is egalitarian instead of selfish. This situation is called the 'hide behind a small cake' effect. This term was first introduced by Güth, Huck, and Ockenfels (1996). If the proposer receives the large endowment, but the responder does not know with certainty what this amount is, the effect occurs when the proposer takes advantage of this lack of knowledge and offers either half or close to half of the lowest possible endowment. The responder then has to consider two possibilities: either the proposer received the large endowment and is 'hiding behind a small cake' to maximize their expected monetary payoff, or the proposer did indeed receive the small endowment and decided to make a 'fair' offer. A reciprocal/egalitarian responder would reject the offer in the first scenario but accept it in the second one.

Kriss, Nagel, and Weber (2013) described the 'hide behind a small cake' effect as a form of implicit deception because it induces others to make incorrect inferences about the true state of the world rather than lying directly. In ultimatum games, implicit deception occurs when the responder can solely convey information regarding the stake through offers (Kriss et al., 2013).

Stress stimulus

One of the methods to measure stress objectively is the use of biological markers that indicate the involuntary response of the organism through the alteration of biological indicators. One such biological marker is the level of cortisol, which increases when an individual faces a stressful event, whether physical or mental. In fact, cortisol has also been called the 'stress hormone' (Fukui & Yamashita, 2003).

Cortisol levels can be obtained through saliva, urine, plasma, sweat, and hair. Salivary cortisol is the most appropriate way to measure cortisol in experimental settings because it is easy to measure, inexpensive, does not require medically trained personnel, and is the most appropriate

marker for changes in response to stressors (Dickerson & Kemeny, 2004; Paza et al., 2017).

Salivary cortisol can be easily assessed using the Salivette® cortisol device, a 10 cm long polypropylene tube with a cotton swab. To collect the sample, the cotton swab is placed in the individual's mouth for about two to three minutes until it is soaked with saliva, and it is then put back in the tube and closed. The electrochemiluminescence method was used to determine the salivary cortisol level of each participant.

One of the main protocols for experimental purposes involving these features is the Trier social stress test (TSST) by Kirschbaum, Pirke, and Hellhammer (1993). The participant is placed in situations involving two tasks: one is a public speaking task for a specified period of five minutes, and the other is mental arithmetic performance in front of an evaluation committee containing three evaluators. The tasks performed and the format of the experiment are designed to make the participant uncomfortable and susceptible to disapproval. This protocol has been shown to be effective as a stress stimulant, increasing cortisol hormone levels, and has been used in studies in psychology and medicine. Dickerson and Kemeny (2004) analyzed 208 laboratory studies and 6,153 participants involving stress stimuli and their response to cortisol levels. They found that tasks involving cognitive effort or public speaking are effective for cortisol responses.

Furthermore, they trigger an even more significant hormone response when performed simultaneously. Even though other methods have been used in the experimental literature to stimulate stress, such as exposure to noise and emotional induction through film, these stimuli do not significantly affect cortisol levels.

There is also a variation of this protocol for group configurations called Trier social stress test for groups (TSST-G), which also involves the characteristics of public speaking and mental arithmetic problem solving for groups of six individuals with a reduction in speech period to two minutes. Both protocols follow the sequence: (1) speech preparation period; (2) speaking task in front of an evaluation committee; and (3) performing mental arithmetic in front of an evaluation committee (Kirschbaum et al., 1993; Von Dawans et al., 2011).

According to Kudielka et al. (2012), cortisol levels may vary across individuals; therefore, the saliva collection was performed before and after the presentation of the stressor, as recommended by Von Dawans, Kirschbaum, and Heinrichs (2011) and Dickerson and Kemeny (2004). Thus, participants provided two saliva samples, baseline and post-manipulation, using the drool method. Their samples were placed in a freezer immediately after collection until they were examined. The procedures for the control group were the same, except for the stress stimuli.

The stressor stimulus involved two stages: conducting mathematical calculations under time pressure and oral exposure. The first stage involved two mathematical tasks, both under time pressure. The first one was a written task, while the second task only involved mental calculations. In the second oral exposure stage, participants talked about their merit for receiving a scholarship from the research program for undergraduates.

Dickerson and Kemeny (2004) recommend that saliva collection be performed with appropriate time of day controls, or that it should be performed at the end of the day (except for studies that assess basal cortisol levels, which should be performed in the morning). This is because cortisol levels are more stable during this period. Therefore, our experiment was conducted between 7 pm and 9 pm following this recommendation. Subsequently, all Salivette® devices were sent for laboratory analysis.

Procedures

Participants were invited two weeks before the experiment by classroom invitations and reminded later. When they arrived for the session, they were randomly assigned to one of the two rooms, where the experiment took place. Thus, when students entered room 1, they participate in the control group or the non-stress induced group, while those who entered 2 received the stress stimulus, and therefore, belonged to the stress-induced group.

After entering each room, the stress-induced group chose their seat in the classroom and received five numbered envelopes. Envelope number 1 contained the instructions for the saliva collection with the stickers provided by the lab; envelope number 2 included a set of mathematics questions (part of the stress stimulus); envelope number 3 contained the game sheet; envelope number 4 had the post-experiment questionnaire; and envelope number 5 contained the documents required by the lab to proceed with the cortisol test. The control group or the non-stress induced group received all envelopes except envelope number 2.

Before opening the envelopes, participants of all groups received all the instructions, which were read aloud, and the experimenter used a script to ensure that the exact words were used in all sessions. The experiment started with the collection of saliva samples using the salivate kit for both groups. We instructed the participants to carefully remove the cotton swab from the ampoule of kit 1 and place it in their mouths to soak it in saliva. After a few minutes with the swab in their mouth, they were instructed to carefully remove it, place it back in the ampoule, and hand it over to the experimenters. Figure 1 illustrates the saliva-collection procedure.

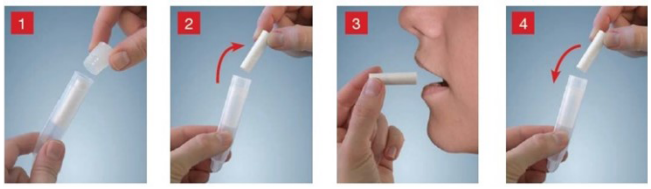

Figure 1. Salivette® cortisol device.
Source: https://www.sarstedt.com.

In the stress-induced group, after receiving stressor stimulation, participants waited 20 minutes, as suggested by Von Dawans, Kirschbaum, and Heinrichs (2011) and Dickerson and Kemeny (2004), and then repeated the saliva collection process with kit 2. In the same way, in the non-stressed group, participants waited the same time as the stress-induced group before the second saliva collection, however, without stress stimulus.

When the second saliva collection was completed, we explained the rules of the modified ultimatum game aloud. To ensure understanding about the game, questions were designed as a way to check understanding. Participants were encouraged to raise their hands and ask questions. Proposers were then informed of the true endowment and were asked to make their offer to the responder using paper and pen.

The experiment followed a 'between-subjects' design, where separate groups received different stimuli, and the results were compared between groups to determine any differences in their results. The variation in cortisol levels was a 'within-subject' factor, i.e., the variation in relation to the stimulus was analyzed for each individual (Kudielka et al., 2012). All proposers were given R$30 to create more opportunities for them to make an offer appear fairer than it was.

Proposers were informed that responders knew the probability distribution of the endowments (R$10 with 50% probability, R$20 with 25% probability, and R$30 with 25% probability). Given that the empirical evidence strongly suggests that offers above 50% of the endowment are extremely rare in the ultimatum game, responders could infer the following from an offer (x is the offer made by the proposer):

a. if $x > 10$, then the initial endowment is R$ 30 with near certainty;

b. if $6 \leq x \leq 10$, then the initial endowment is either R$20 or R$30;

c. if $x \leq 5$, then the initial endowment can be either R$10, R$20, or R$30.

Since we gave R$30 to all proposers, we used this information during the experiment to observe its effects on the decision-making process with larger opportunities to incur returns based on the 'hiding behind a small cake' effect. In the debriefing stage, we clarified these aspects of the experiment to all participants. The payment to proposers was made the following day, at the same time and place. Each session lasted for about 50 minutes. This study was approved by the ethics committee of the university. Thus, after completing the experiment, participants were debriefed and thanked for their participation.

Sample

Our sample comprised 111 individuals; 26 participants were excluded from the analysis because they did not complete the experiment, provided insufficient saliva for laboratory analysis, or gave incomplete or incomprehensive responses in the decision sheet. We also excluded from our sample outlier's cortisol levels compared to the average of both control and treatment groups. Thus, our final sample had 85 participants. Eleven experimental sessions were conducted, with 6 to 11 participants in each session due to the time consumed for saliva collection. Table 1 presents the descriptive statistics for the sample, showing its homogeneity.

Table 1. Descriptive statistics for the sample.

	Treatment group	Control group	Mann-Whitney test
Age	21.97 (3.23)	21.02 (3.07)	z = 1.36; p-value = 0.17
Income average	2.27 (2.05)	2.05 (2.27)	z = 1.51; p-value = 0.13
Male	55%	47%	z = -0.84; p-value = 0.40
Sample size	47	38	

Note. 'Age' represents the average age of the group in years; 'Income average' represents the average score on the group on a five-point scale (from 1 to 5), according to the five-point Brazilian income scale based on the monthly Brazilian federal minimum wage: 1 = below R$1,576; 2 = between R$1,576 and R$3,152; 3 = between R$3,152 and R$7,880; 4 = between R$7,880 and R$15,760; 5 = above R$15,760. 'Male' represents the percentage of males in the group. Standard deviations in brackets.

Participants were young adult college students from a business school (majoring in economics, business administration, or accounting). They were instructed not to eat or drink anything (besides water), use tobacco, brush

their teeth, or engage in any exercise three hours before the experiment. A list of criteria was used to select appropriate participants before the start of the experiment.

RESULTS

We found that the stress stimulus changed the subject's cortisol levels, although with some variation. Despite these individual differences, however, we found a close positive relationship between increased cortisol levels and offers in the game. Even though we cannot entirely discard the possibility that stress is causing subjects to be more prosocial, it seems that stressed individuals did not consider the full potential to deceive the second player, and the 'hide behind a small cake' effect was not fully exploited.

Statistical analyses

First, we analyzed the efficiency of the stressor stimulus between the study conditions (with and without stimulus). Second, we analyzed the variation in cortisol levels by comparing the first and second collection values. Table 2 presents the descriptive statistics related to salivary cortisol levels.

Table 2. Descriptive statistics related to salivary cortisol level (mg/dl).

	Both conditions		'Without stress stimulus' condition		'With stress stimulus' condition	
Cortisol collection order	Before*	After**	Before	After	Before	After
Mean	0.139	0.21	0.137	0.142	0.142	0.261
SD	0.048	0.118	0.047	0.047	0.050	0.132
Min	0.06	0.06	0.06	0.07	0.07	0.10
Max	0.27	0.67	0.23	0.24	0.27	0.67
Sample size	85	85	38	38	47	47
Effect size	Cohen's d = 1.3806 Eta-squared = .3227329					
Difference between cortisol levels at the first collection in the 'with' and 'without stress stimulus' conditions*					z = 0.37; p-value = 0.71	
Difference between cortisol levels at the second collection in the 'with' and 'without stress stimulus' conditions ***					z = 5.08; p-value = 0.00	
Difference between cortisol levels at the first and second collection in the 'without stress stimulus' condition ****					z = 1.62; p-value = 0.10	
Difference between cortisol levels at the first and second collection in the 'with stress stimulus' condition ****					z = 5.97; p-value = 0.00	

Note. * Before presenting the stress stimulus; ** After presenting the stress stimulus; *** Mann-Whitney test (between subjects); **** Wilcoxon signed-rank test (within-subjects).

No statistically significant difference was found between salivary cortisol levels at the first collection in both conditions (with and without stress stimulation). However, a statistically significant difference was observed between both conditions regarding the salivary cortisol level at the second collection. Additionally, we did not find any significant difference between the salivary cortisol levels in the 'without stress stimulus' condition in the first and second collections. Still, this difference was significant in the 'with stress stimulus' condition. Together, these results indicate that the stress stimulus increased participants' cortisol levels.

After observing the stress stimulus manipulation efficiency, we analyzed if the increase in cortisol levels was related to participants' responses in the ultimatum game with asymmetric information. Table 3 presents the descriptive statistics related to the transfers made from proposers to responders.

As evident from Table 3, the presence of the stress stimulus was relevant to the decisions made by proposers. Specifically, participants tended to increase their offers under stress in the game. According to the Mann-Whitney test (z = -2.389; p-value = 0.016), there was a statistically significant difference in the offers made by both groups. Figure 2 presents the distribution of offers in both conditions.

Table 3. Descriptive statistics for offers in the ultimatum game.

	Without stress stimulus	With stress stimulus
Mean	9.86	12.44
Median	10	15
Mode	10	10
Standard deviation	3.79	5.53
Min	5	0
Max	20	30
Sample size	38	47

Note. Developed by the authors.

According to Figure 2, offers of R$10 were the most frequent in both treatment groups. Suppose proposers wanted to maximize their monetary outcome, conditional on believing that responders are likely to behave reciprocally (as observed in the literature) and think there is a sufficiently high probability that the initial endowment was R$10. In that case, the predicted offer should be R$5 to transmit the idea that the total amount given to the proposer was R$10. By sending R$10 to the responder, the proposer's likely intention was to send a message that the initial endowment was R$20 or R$30. The psychological costs of deceiving the responder or the fear of rejection might also explain these offers (Rosenbaum et al., 2014).

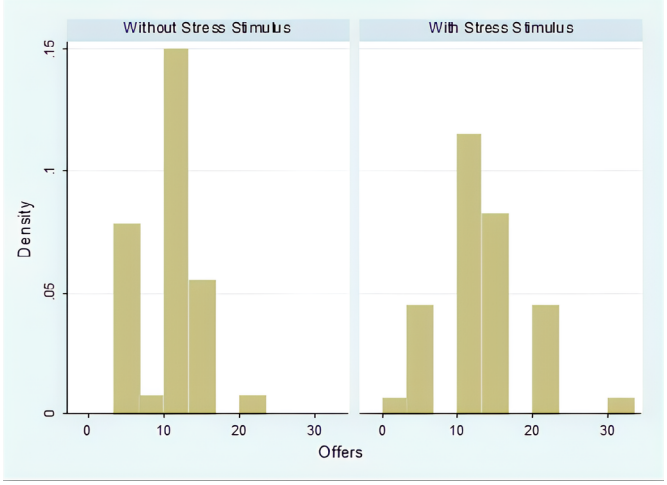

Figure 2. Offers in the ultimatum game — with and without stress stimulus conditions.
Source: Developed by the authors.

Nevertheless, the observed patterns of both groups were distinct. In the presence of stress stimuli, we observed a decrease in offers of R$5 and an increase in offers of R$15 and R$20.

At first, it seemed that participants became more generous in their offers under stress. We further examined the proposer's perception regarding the responder's ability to guess the actual endowment in the game. In the post-game questionnaire, we asked proposers about the responders' beliefs about the true endowment. We called this information 'reported beliefs.' The main idea was to observe the decision-making process by considering the proposer's beliefs relative to the responder's beliefs about the true endowment in the game.

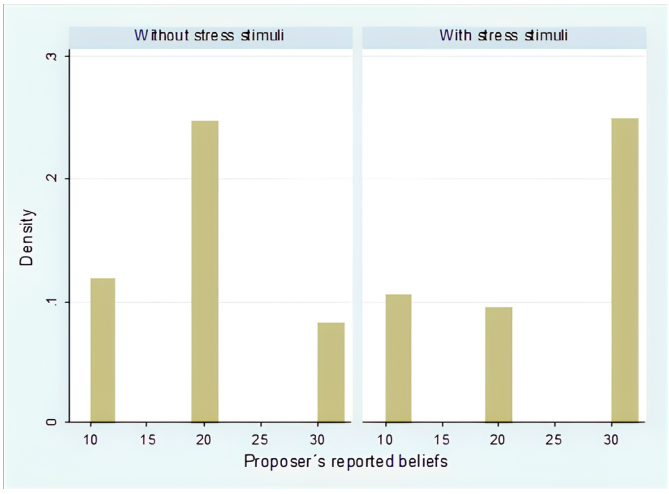

Figure 3. Proposer's beliefs regarding responder's beliefs about the initial endowment.
Source: Developed by the authors.

Figure 3 shows that participants under stress treatment reported an increase in their perception regarding the responder's ability to guess the actual cake size in the game. According to the proposer's 'reported beliefs,' stress stimuli diminished the proposer's probabilistic belief that he could successfully 'hide behind a small cake'.

We conducted some additional analyses. Based on the offers in the game, we proposed three main categories: (a) strategic-selfish offers; (b) Social preference offers; and (c) fair offers.

Strategic-selfish offers can be used to make them appear more generous than they actually are to avoid rejection, taking advantage of the 'hide behind a small cake' effect. We considered an offer 'strategic-selfish' when offers were lower than 50% of the actual cake size.

Social preference offers reveal not only an intention to retain more or avoid rejection, but also demonstrate some other-regarding concerns. These offers are larger than they should be to avoid rejection, which shows an intention to give more when having the opportunity to offer less. We assumed that offers fit the 'social preferences' category when they exceed 50% of the cake.

Finally, the 'fair' category was composed of offers equal to 50% of the amount received by the proposer in the game, which probably showed a desire to be fair, not taking advantage of the asymmetric information condition.

We decoded each category observed to incorporate them in our regression models as binary variables. The aforementioned three major categories were coded as follows:

a. strategic-selfish offers: a value of one when offers were characterized by splits where offers were lower than 50% of the endowment in the game (when the proposer retained more than the responder) and zero otherwise;

b. social preference offers: a value of one when transfers were higher than 50% of the true endowment and zero otherwise;

c. fair offers: a value of one when transfers were equal to 50% of the true endowment in the game and zero otherwise;

We also created three additional variables to complement our analysis: the variables 'stress,' 'beliefs,' and 'diff':

d. stress: dummy variable with a value of one when participants received stress stimulus and zero otherwise;

e. beliefs: interactive variable between the dummy for stress treatment and the dummy variable for the proposer's perception regarding the responder's ability to guess the real cake size in the game (R$30). This data was collected through the post-game questionnaire. A value of one was assigned when proposers were stress-stimulated and believed the responder thought the initial endowment was correct (R$30) and zero otherwise;

f. diff: the change in salivary cortisol, or the result of the second salivary cortisol measure minus the first.

We used the tobit model in the regression analysis because we observed a sizable number of transfers equal to the smallest possible transfer (R$0) and the largest possible transfer (R$30). A logit model was used when the dependent variable was a dummy for the proposed categories.

Table 4. Regression models.

Dependent variables	Tobit Model 1 *Offers*	Tobit Model 2 *Offers*	Tobit Model 3 *Offers*	Logit Model 4 *Selfish-Strategic offers*	Logit Model 5 *Fair offers*	Logit Model 6 *Social offers*
Stress	2.883*** (1.07)		-.3999 (1.414)	-.449 (.642)	.208 (667)	2.454*** (1.217)
Diff		8.219*** (5.360)	9.076 (6.155)			
Beliefs		4.005*** (1.140)	4.179*** (1.342)	-1.570*** (.661)	1.886*** (.696)	.315 (.801)
Age	-.1898 (.168)	-.1677 (.156)	.1601 (.159)	. 022 (.082)	.022 (.082)	.146 (.118)
Gender	.749 (1.059)	.694 (.988)	.7105 (.989)	.228 (.506)	-.108 (.516)	-.378 (.771)
Income	-.896 (.699)	-1.272 (.664)	(-1.138) (.666)	.524 (.356)	-.644 (.371)	-.857 (.551)

Note. * 90% confidence level; ** 95% confidence level; *** 99% confidence level. SD in parentheses. $Offers_{ij}$ = transfer in the game from proposer *i* to responder *j* (in Brazilian reais, from 0 to 30). $Stress_j$ = binary variable for stress stimulus presence; Age_i = proposer's age (in years). $Male_i$ = binary variable for the proposer's gender (1 = male). $Income_i$ = proposer's income level (from 1 to 5), according to the five-point Brazilian income scale based on the monthly Brazilian federal minimum wage: 1 = below R$1,576; 2 = between R$1,576 and R$3,152; 3 = between R$3,152 and R$7,880; 4 = between R$7,880 and R$15,760; 5 = above R$15,760.

Model 1 shows that the presence of the stressor stimulus contributed to an increase in offers in the ultimatum game, which might have reduced the use of the 'hiding behind a small cake' effect. Results from Model 2 were similar to those from Model 1, and they confirmed that participants with higher salivary cortisol variance chose to make larger offers to the responder on average. Besides, this model shows that proposers made larger transfers when they believed that responders would guess the true endowment in the game. Model 3 emphasized the role of beliefs under stress to increase the offers in the game. Model 4 showed that selfish-strategic offers were negatively related to the perception that the responder would guess the true initial endowment, suggesting that stressed participants were less likely to take advantage of the 'hide behind a small cake' effect. And similarly, Model 5 showed that fair offers were more likely when the proposer believed that the responder would guess the true endowment. Thus, it seems that stressed participants increased their perception regarding the other player's ability to guess the true endowment, which increased the offers in the game. On the other hand, social preference offers were statistically significant under stress, according to Model 6, showing that stress might have increased the offers in the game.

The combination of all these results suggests that the proposer's perception regarding the ability of the responder to guess the true endowment increased with stress stimulus, which also increased offers in the ultimatum game. In addition, the 'hide behind a small cake' effect was more frequently observed in the treatment without stress stimulation. Finally, we also observed that, under stress stimulus, participants were more likely to be more generous when compared to the control group.

DISCUSSION AND CONCLUSIONS

Most of the literature related to decision-making and stress has shown that stressed individuals usually search for a reward that benefits them, and stress becomes an excuse to behave deceitfully (Bendahan et al., 2017; Fox et al., 2001; Gravert, 2013; Jones & Boye, 1994; Nickels et al., 2017; Starcke et al., 2011; Takagishi et al., 2009). Our results suggest a more nuanced set of behaviors. We found that participants increased their offers in the game in the stress condition. However, this perceived increase in fairness/generosity under stress was probably not the leading cause of this effect associated with the stress stimulus.

When we analyzed proposers' beliefs about responders' beliefs about the in-game endowment, we found that proposers who made larger transfers also tended to be the ones who believed that the responder would guess the actual endowment correctly. Thus, their fear of rejection was the likely driver of this increase in offers. From this standpoint, one possible effect of stress could be an increase in risk perception. Furthermore, stress may lead to a decrease in the proposers' awareness of the potential of the game to increase their payoff by using strategic-selfish actions. In this respect, our study is in line with the findings of Starcke and Brand (2016), who highlight that stress can negatively affect individuals' ability to make thoughtful decisions, leading to a bias toward impulsive responses and a decrease in the consideration of relevant information. It is also possible that the stressful condition have rendered our participants less capable of realizing the 'hide behind a small cake' potential of the game due to an increase in their risk perception, leading them to make more conservative offers.

On the other hand, the control group (without stress stimulus) showed more accuracy in understanding the potential to use asymmetric information to gain an advantage in the game. Thus, they utilized the 'hide behind a small cake' effect more frequently. We also observed that more generous offers happened when participants were under stress, even when their risk perception seemed not to have increased. In this perspective, the stress stimulus had at least two main effects: the proposers' overestimation of the responder's ability to guess the true endowment in the game and larger offers.

Although the precise mechanism through which stress influences risk perception remains incompletely understood and necessitates further investigation, we can draw upon Porcelli and Delgado's (2017) suggestion regarding a potential mechanism by which stress may elevate risk perception. This mechanism involves the modulation of emotional processing and reward systems within the brain, which can alter our assessment and valuation of potential outcomes and influence our inclination to take risks. In terms of risk perception, stress can impact the processing and interpretation of pertinent information within a given situation. This can result in an intensified perception of threat or the likelihood of unfavorable outcomes, consequently heightening the perception of risk. Moreover, stress can modulate the activity of brain regions implicated in risk evaluation, such as the amygdala and prefrontal cortex, thus influencing subjective risk perception.

From a different perspective, the study conducted by Hengen and Alpers (2021) sheds light on the interaction between stress, anxiety, and risk assessment. Their findings indicate that individuals with high anxiety levels exhibit greater risk aversion when placed under stressful conditions. It is worth noting that our study did not specifically control for participants' anxiety levels to examine this particular interaction. Nonetheless, we acknowledge the potential influence of anxiety in the observed outcomes. Therefore, future research could greatly benefit from incorporating such controls to further explore this relationship.

In addition, it is important to consider the insights provided by studies conducted by Buchanan and Preston (2014) and Yu (2016), which shed further light on the impact of stress on decision-making processes. These studies emphasize that stress can induce a cognitive shift from analytical thinking to intuitive processing, resulting in biased and less rational decision-making. When individuals are under stress, they tend to rely more on rapid and heuristic judgments, displaying reduced levels of reflection and weighing of information. Consequently, this cognitive shift may account for the observed phenomenon of a propensity toward higher values in stressful situations. Moreover, the capacity for reflective thinking and the utilization of relevant information may be compromised, leading to decisions that are less informed and potentially suboptimal. In light of these findings, it becomes evident that stress can exert a negative influence on individuals' ability to make rational and strategic decisions.

NOTES

1. Dual process theory, popularized by the Nobel Prize Daniel Kahneman, distinguishes between families of cognitive operations, called Type 1 (intuitive) and Type 2 (analytical thinking), which are used in decision-making. Type 1 is often described as a reflex system, which is 'intuitive' and 'experiential' or 'pattern recognition,' which triggers an automated mode of thinking. Type 2 is the more 'analytical,' 'deliberate,' and 'rational' side of the thinking process. It is pieced together by logical judgment and a mental search for additional information acquired through past learning and experience.

REFERENCES

Appelbaum, S. H., Iaconi, G. D., & Matousek, A. (2007). Positive and negative deviant workplace behaviors: causes, impacts, and solutions. *Corporate Governance: The International Journal of Business in Society*, *7*(5), 586-598. https://doi.org/10.1108/14720700710827176

Bendahan, S., Goette, L., Thoresen, J., Loued-Khenissi, L., Hollis, F., & Sandi, C. (2017). Acute stress alters individual risk taking in a time-dependent manner and leads to anti-social risk. *European Journal of Neuroscience*, *45*(7), 877-885. https://doi.org/10.1111/ejn.13395

Besancenot, D., Dubart, D., & Vranceanu, R. (2013). The value of lies in an ultimatum game with imperfect information. *Journal of Economic Behavior and Organization*, *93*, 239-247. https://doi.org/10.1016/j.jebo.2013.03.029

Buchanan, T. W., & Preston, S. D. (2014). Stress leads to prosocial action in immediate need situations. *Frontiers in Behavioral Neuroscience*, *8*, 5. https://doi.org/10.3389/fnbeh.2014.00005

Cappelletti, D., Güth, W., & Ploner, M. (2011). Being of two minds: Ultimatum offers under cognitive constraints". *Journal of Economic Psychology*, *32*(6), 940-950. https://doi.org/10.1016/j.joep.2011.08.001

Chavanne, D., & Ferreira, M. (2017). When knowledge is not power: Asymmetric information, probabilistic deceit detection and threats in ultimatum bargaining. *Journal of Behavioral and Experimental Economics*, *69*, 4-17. https://doi.org/10.1016/j.socec.2017.05.004

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychological Bulletin*, *130*(3), 355. https://doi.org/10.1037/0033-2909.130.3.355

Fox, S., Spector, P. E., & Miles, D. (2001). Counterproductive work behavior (CWB) in response to job stressors and organizational justice: Some mediator and moderator tests for autonomy and emotions. *Journal of Vocational Behavior*, *59*(3), 291-309. https://doi.org/10.1006/jvbe.2001.1803

Fukui, H., & Yamashita, M. (2003). The effects of music and visual stress on testosterone and cortisol in men and women. *Neuro Endocrinology Letters*, *24*(3-4), 173-180. https://pubmed.ncbi.nlm.nih.gov/14523353/

Gneezy, A., & Ariely, D. (2010). "Don't get mad get even: On consumers' revenge". Duke University.

Gneezy, U. (2005). Deception: The role of consequences". *American Economic Review*, *95*(1), 384-394. http://dx.doi.org/10.1257/0002828053828662

Gravert, C. (2013). How luck and performance affect stealing. *Journal of Economic Behavior & Organization*, *93*, 301-304. https://doi.org/10.1016/j.jebo.2013.03.026

Güth, W., Huck, S., & Ockenfels, P. (1996). Two-level ultimatum bargaining with incomplete information: An experimental study. *The Economic Journal*, *106*(436), 593-604. https://doi.org/10.2307/2235565

Güth, W., Schmittberger, R., & Schwarze, B. (1982). An experimental analysis of ultimatum bargaining. *Journal of Economic Behavior and Organization 3*(4), 367-388. https://doi.org/10.1016/0167-2681(82)90011-7

Hengen, K. M., & Alpers, G. W. (2021). Stress makes the difference: Social stress and social anxiety in decision-making under uncertainty. *Frontiers in Psychology*, *12*, 578293. https://doi.org/10.3389/fpsyg.2021.578293

Henle, C. A. (2005). Predicting Workplace deviance from the interaction between organizational justice and personality. *Journal of Managerial Issues*, *17*(2), 247–263. http://www.jstor.org/stable/40604498

Henle, C. A., Giacalone, R. A., & Jurkiewicz, C. L. (2005). The role of ethical ideology in workplace deviance". *Journal of Business Ethics*, 56(3), 219-230. https://doi.org/10.1007/s10551-004-2779-8

Jex, S. M., & Beehr, T. A. (1991). Emerging theoretical and methodological issues in the study of work-related stress. *Research in Personnel and Human Resource Management*, 9, 311–365.

Jones, J. W., & Boye, M. W. (1994). Job stress, predisposition to steal, and employee theft. *American Journal of Health Promotion*, *8*(5), 331-333. https://doi.org/10.4278/0890-1171-8.5.331

Kajackaite, A., & Gneezy, U. (2017). Incentives and cheating. *Games and Economic Behavior,* 102, 433-444. https://doi.org/10.1016/j.geb.2017.01.015

Keefer, L. Keshavarzian, A., & Mutlu, E. (2008). Reconsidering the methodology of "stress" research in inflammatory bowel disease. *Journal of Crohn's and Colitis*, *2*(3), 193-201. https://doi.org/10.1016/j.crohns.2008.01.002

Keinan, G. (1987). Decision making under stress: scanning of alternatives under controllable and uncontrollable threats. *Journal of Personality and Social Psychology*, *52*(3), 639–644. 639. https://doi.org/10.1037/0022-3514.52.3.639

Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test'–a tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, *28*(1-2), 76-81. https://doi.org/10.1159/000119004

Kriss, P. H., Nagel, R., & Weber, R. A. (2013). Implicit vs. explicit deception in ultimatum games with incomplete information. *Journal of Economic Behavior and Organization*, 93, 337-346. https://doi.org/10.1016/j.jebo.2013.03.024

Kudielka, B. M., Gierens, A., Hellhammer, D. H., Wüst, S., & Schlotz, W. (2012). Salivary cortisol in ambulatory assessment—some dos, some don'ts, and some open questions. *Psychosomatic Medicine*, *74*(4), 418-431. https://doi.org/10.1097/psy.0b013e31825434c7

Lupien, S. J., Maheu, F., Tu, M., Fiocco, A., & Schramek, T. E. (2007). The effects of stress and stress hormones on human cognition: Implications for the field of brain and cognition. *Brain and cognition*, *65*(3), 209-237. https://doi.org/10.1016/j.bandc.2007.02.007

Mazar, N., Amir, O., & Ariely, D. (2008). The dishonesty of honest people: A theory of self-concept maintenance. *Journal of Marketing Research*, *45*(6), 633-644. https://doi.org/10.1509/jmkr.45.6.633

Moustafa, A. A., Tindle, R., Frydecka, R., & Misiak, B. (2017). Impulsivity and its relationships with anxiety, depression and stress. *Comprehensive Psychiatry, 74*, 173-179. https://doi.org/10.1016/j.comppsych.2017.01.013

Nickels, N., Kubicki, K., & Maestripieri, D. (2017). Sex differences in the effects of psychosocial stress on cooperative and prosocial behavior: Evidence for 'flight or fight'in males and 'tend and befriend'in females. *Adaptive Human Behavior and Physiology*, *3*, 171-183. https://doi.org/10.1007/s40750-017-0062-3

Ockenfels, A., & Werner, P. (2012). Hiding behind a small cake in a newspaper dictator game". *Journal of Economic Behavior and Organization*, *82*(1), 82-85. https://doi.org/10.1016/j.jebo.2011.12.008

Paza, D. L. S., Pierozan, G. C., Furyama, G. Y., & Stefanello, J. M. F. (2017). Cortisol capilar como medida de análise do estresse crônico". *Psicologia, Saúde e Doenças*, *18*(3), 773-788. http://dx.doi.org/10.15309/17psd180312

Porcelli, A. J., & Delgado, M. R. (2017). Stress and decision making: Effects on valuation, learning, and risk-taking. *Current Opinion in Behavioral Sciences*, *14*, 33-39. https://doi.org/10.1016/j.cobeha.2016.11.015

Preston, S. D., Buchanan, T.W., Stansfield, R.B., & Bechara, A. (2007). Effects of anticipatory stress on decision making in a gambling task. *Behavioral Neuroscience*, *121*(2), 257-263. https://doi.org/10.1037/0735-7044.121.2.257

Raio, C. M., Konova, A. B., & Otto, A. R. (2020). Trait impulsivity and acute stress interact to influence choice and decision speed during multi-stage decision-making. *Scientific Reports, 10*(7754). https://doi.org/10.1038/s41598-020-64540-0

Rosenbaum, S. M., Billinger, S., & Stieglitz, N. (2014). Let's be honest: A review of experimental evidence of honesty and truth-telling. *Journal of Economic Psychology*, *45*, 181-196. https://doi.org/10.1016/j.joep.2014.10.002

Simonovic, B., Stupple, E. J., Gale, M., & Sheffield, D. (2018). Performance under stress: An eye-tracking investigation of the Iowa Gambling Task (IGT). *Frontiers in Behavioral Neuroscience*, *12*,1-10. https://doi.org/10.3389/fnbeh.2018.00217

Spector, P. E. (1998). A control theory of the job stress process", In in C. L. Cooper (Ed.), Theories of Organizational Stress (pp.153-169). Oxford University Press.

Starcke, K., Polzer, C., Wolf, O. T., & Brand, M. (2011). Does stress alter everyday moral decision-making? *Psychoneuroendocrinology, 36*(2), 210-219. https://doi.org/10.1016/j.psyneuen.2010.07.010

Starcke, K., & Brand, M. (2012). Decision making under stress: a selective review. *Neuroscience & Biobehavioral Reviews*, *36*(4), 1228-1248. https://doi.org/10.1016/j.neubiorev.2012.02.003

Starcke, K., & Brand, M. (2016). Effects of stress on decisions under uncertainty: A meta-analysis. *Psychological Bulletin*, *142*(9), 909-933. https://doi.org/10.1037/bul0000060

Starcke, K., Agorku, J. D., & Brand, M. (2017). Exposure to unsolvable anagrams impairs performance on the Iowa Gambling Task. *Frontiers in Behavioral Neuroscience, 11*, 114. https://doi.org/10.3389/fnbeh.2017.00114

Takagishi, H., Fujii, T., Kameshima, S., Koizumi, M., & Takahashi, T. (2009). Salivary alpha-amylase levels and rejection of unfair offers in the ultimatum game. *Neuroendocrinology Letters*, *30*(5), 643. https://www.ncbi.nlm.nih.gov/pubmed/20035253

Vesely, S. (2014). Ultimatum game with asymmetric information: A study of deception and fairness. *Studia Psychologica*, *56*(1), 53. http://dx.doi.org/10.21909/sp.2014.01.650

Von Dawans, B., Kirschbaum, C., & Heinrichs, M. (2011). The Trier Social Stress Test for Groups (TSST-G): A new research tool for controlled simultaneous social stress exposure in a group format. *Psychoneuroendocrinology*, *36*(4), 514-522. https://doi.org/10.1016/j.psyneuen.2010.08.004

Yu, R. (2016). Stress potentiates decision biases: A stress induced deliberation-to-intuition (SIDI) model. *Neurobiology of Stress*, *3*, 83-95. https://doi.org/10.1016/j.ynstr.2015.12.006

Authorship

Erika Mirian Nogas
Pontifícia Universidade Católica do Paraná
Rua Imaculada Conceição, n. 1500, Rebouças, CEP 80215-182, Curitiba, PR, Brazil
E-mail: erika.mirian@pucpr.br
https://orcid.org/0000-0002-1850-2418

Angela Cristiane Santos Póvoa*
Pontifícia Universidade Católica do Paraná
Rua Imaculada Conceição, n. 1500, Rebouças, CEP 80215-182, Curitiba, PR, Brazil
E-mail: angela.povoa@pucpr.br
https://orcid.org/0000-0002-6878-9517

Wesley Pech
Tennessee Tech University
1 William L Jones Dr, ZIP 38505, Cookeville, TN, USA
E-mail: wpech@tnttech.edu
https://orcid.org/0000-0003-3962-3398

* Corresponding Author

Conflict of Interests

The authors have stated that there is no conflict of interest.

Copyrights

Peer Review Method

This content was evaluated using the double-blind peer review process. The disclosure of the reviewers' information on the first page, as well as the Peer Review Report, is made only after concluding the evaluation process, and with the voluntary consent of the respective reviewers and authors.

Authors' Contributions

1st author: data curation (lead), formal analysis (equal), investigation (equal), methodology (equal), project administration (supporting), writing – original draft (lead).

2nd author: conceptualization (lead), formal analysis (equal), funding acquisition (lead), project administration (equal), software (equal).

3rd author: conceptualization (equal), formal analysis (lead), methodology (equal), supervision (equal), writing – review & editing (lead).

Funding

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) – Finance Code 001.

Plagiarism Check

RAC maintains the practice of submitting all documents approved for publication to the plagiarism check, using specific tools, e.g.: iThenticate.

Data Availability

The authors claim that all data used in the research have been made publicly available through the Harvard Dataverse platform and can be accessed at:

Erika Mirian Nogas; Angela Cristiane Santos Póvoa; Wesley Pech, 2023, "Replication Data for: "Decision making under stress: The "hiding behind a small cake" effect" published by RAC-Revista de Administração Contemporânea", Harvard Dataverse, V1. https://doi.org/10.7910/DVN/SPG1PC

RAC encourages data sharing but, in compliance with ethical principles, it does not demand the disclosure of any means of identifying research subjects, preserving the privacy of research subjects. The practice of open data is to enable the reproducibility of results, and to ensure the unrestricted transparency of the results of the published research, without requiring the identity of research subjects.

RAC is a member of, and subscribes to the principles of the Committee on Publication Ethics (COPE) for scholarly publication

COPE Member since 2020 JM14878