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Escalation of commitment is independent of numeracy and cognitive reflection. Failed replication and extension of Staw (1976)[1]

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Abstract: First demonstrated by Staw (1976), escalation of commitment is the tendency for an individual to increase their commitment to a failing course of action when they are personally responsible for the negative consequences. An attempt was made to replicate this finding and test whether individual differences in numeracy and cognitive reflection could help explain such an effect. No evidence for escalation of commitment amongst the participants was found (N = 365). Participants simply invested more in more promising projects. Also, no evidence was found that numeracy or cognitive reflection predict escalation behaviour. The validity of escalation of commitment behaviour is discussed which suggests that future work should look to explore the boundary conditions of such an effect.

Keywords: escalation of commitment, sunk cost, numeracy, cognitive reflection.

JEL code: D91.

Introduction

Imagine you are the Chief Financial Officer of a large, international company. A few years ago the company was in a precarious financial situation and its board of directors voted that only one of two major product development programmes would receive an additional $10M in funding. Due to the nature of your position, you decided which of the two programmes received the increased investment. Five years have passed since this decision and the com-

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pany's finances are re-evaluated. An additional $20M is made available to be further invested in the two programmes. This time you can freely allocate the funds as you wish. Upon looking at the financial returns provided from both programmes since you made the initial investment you discover that the programme you chose performed poorly (continued to generate a net loss) and the programme you did not choose performed well (went from generating a net loss to a net gain). How would you allocate the funds? Now imagine that you had only recently taken over as Chief Financial Officer and therefore were not responsible for the initial investment decision. Would your allocation change?

In such a scenario people allocated far more resources to the failing programme when they made the initial decision to invest compared to when did not (Staw, 1976). This escalation of commitment is a violation of expected utility theory as the allocation of funds to be decided should not be affected by whom made the previous decision. Yet people become further entrenched in a failing course of action when they are personally responsible for the negative consequences.

In this work an unsuccessful replication and extension of Staw (1976) is reported. Section 1 introduces the phenomenon of escalation of commitment, Section 2 discusses factors leading people to escalate commitment and Section 3 reports the replication. All data and materials for this experiment are posted in the Open Science Framework repository, https://osf.io/vcnp6/. They were translated into Polish by two native speakers of the authorship team.

1. Escalation of commitment

Some factors leading individuals to escalate commitment include the appeal of unrecoverable sunk costs of money or time (Arkes & Blumer, 1985; Meyers, Białek, Fugelsang, Koehler, & Friedman, 2019), the urge to do something rather than nothing after receiving negative feedback (Feldman & Wong, 2018), and to protect self-identity by justifying past decisions with future decisions (Brockner et al., 1986). However, this list is far from exhaustive (see Brockner, 1992; Sleesman, Conlon, McNamara, & Miles, 2012; Sleesman, Lennard, McNamara, & Conlon, 2018 for extensive reviews). Notably cognitive mechanisms underlying escalation of commitment have been underexplored.

The present work aims to replicate the seminal escalation of commitment work by Staw (1976) and extend it by assessing potential cognitive mechanisms underlying the behaviour. There have been several attempts to replicate such work, which have produced mixed results. For example, escalation of commitment was present in simulated managerial decisions (Schoorman, Mayer, Douglas, & Hetrick, 1994) but was not observed in a marketing context (Armstrong, Coviello, & Safranek, 1993). Moreover, German, but not Chinese, participants escalated commitment (Pedell, Rötzel, & Seethamraju, 2017). Some of the inconsistencies in the replications could be attributed to individual dif-

ferences of tested individuals. In this project, numerical ability and reflective thinking style were tested to see if these predict differences in the tendency to escalate commitment in the face of a failing course of action. Numeracy and cognitive reflection have been repeatedly shown to predict engagement in various biased behaviours, including honoring sunk costs (Pennycook, Fugelsang, & Koehler, 2015a), even after accounting for differences in intelligence (Sobkow, Olszewska, & Traczyk, 2020; Stanovich & West, 2008).

Escalation of commitment can be seen as one of the many faces of sunk cost fallacy. The typical study on sunk cost uses vignettes similar to the example above in which people continue to invest in a failing project because they have previously invested in it (Arkes & Ayton, 1999). Such behaviour is observed in real life in doctors continuing to unsuccessfully treat a patient despite not being willing to start the same treatment for another patient with identical symptoms (Turpin, Meyers, Fugelsang, Friedman, & Białek, 2019) and in penny auctions where all bidders are obligated to pay their last bid but only the largest bid wins the product (Augenblick, 2016). However, the sunk cost fallacy does not consistently emerge in experiments purporting to directly test for it (e.g., Friedman, Pommerenke, Lukose, Milam, & Huberman, 2007). For example, Negrini, Riedl and Wibral (2020) demonstrated both a sunk cost effect in traditional hypothetical scenarios and a reverse sunk cost effect in a behavioural paradigm within the same sample of participants. The inconsistent rate at which sunk costs effects are found and the not-so-well understood conditions required to produce them could lead to a reasonable concern that escalation of commitment might face similar circumstances.

2. Prediction of escalation of commitment

Numeracy and cognitive reflection can plausibly predict escalation of commitment. First, consider that escalation of commitment is a decision bias not a decision error. Accounts of the phenomenon provide conditions (e.g., the presence of sunk costs, when the individual's social reputation is at risk) under which individuals will be predictably irrational by escalating their commitment (Arkes, 1996; Arkes & Hutzel, 2000).

From a dual process perspective biased decision making is usually the product of Type 2 processing failing to override Type 1 processes (Evans & Stanovich, 2013). Type 1 processes are autonomous and automatic and are thought to produce our intuition. They are triggered every time an agent detects corresponding stimuli and we have no access to the content of the processes, only its output (Thompson, Turner, & Pennycook, 2011). While Type 1 processes are quite often extremely powerful (Raoelison, Thompson, & De Neys, 2020) they can sometimes lead us astray, perhaps like in escalation of commitment scenarios. Type 2 processes are controlled, require shared cognitive resources to operate

and are thought to produce our reflection. Type 2 processes are not constantly firing; they must be activated by the individual. Often such reflective processes are required when one has detected an erroneous Type 1 output. However, individuals vary in their willingness to engage corrective Type 2 processes (Białek, Domurat, & Meyers, 2021; Meyers, Walker, Fugelsang, & Koehler, 2020).

Individual differences in the tendency to engage in cognitive reflection are measured in part by the Cognitive Reflection Test (Frederick, 2005). This famous three item test has been demonstrated to be a strong predictor of various decision biases (e.g., Cheng & Janssen, 2019) that often require Type 2 processing to override erroneous Type 1 outputs. Similarly, numeracy can be seen as part of an individual's "Algorithmic Mind" (Stanovich, Toplak, & West, 2016), which represents the strength or computational ability of an individual's Type 2 processing. In other words, numeracy can be thought of as how well an individual's Type 2 processing is able to deal with numerical information.

While cognitive reflection represents an individual's willingness to engage in reflective processes numeracy represents the strengths of those processes. If escalation behaviour is the product of failing to engage reflective processing when it is required, then it might be expected that cognitive reflection predicts escalation behavior. If the bias is the product of having insufficient ability to find the rational course of action, it might be expected that numeracy predicts it. In addition, it is possible that each of these scenarios is true to some extent and it might be expected that they both predict escalation behaviour. Finally, one more possible alternative is that neither cognitive reflection nor numeracy predict it. This might be expected if escalation of commitment has little to do with reflective processing in general, or when reflection is used to justify intuitive output rather than to correct it (Pennycook, Fugelsang, & Koehler, 2015b).

The present work examines whether a dual process account of escalation of commitment might help further explain why humans engage in such irrational escalation behaviour. Specifically, it was assessed whether an individual's willingness to engage in cognitive reflection and whether an individual's ability to reflectively process numerical information can predict escalation of commitment. The prediction was that scoring high in each factor will help decision makers to stop a failing investment in light of negative feedback and whether these traits affect the discrepancy between prior decisions made by the self versus by a different person.

3. The experiment

3.1. Participants

Polish speaking participants (N = 425) were recruited in roughly equal number through word-of-mouth and social media, and by means of a paid partici-

pants' pool: Prolific Academic. Because neither a comprehension check nor attention controls were included, it was decided to remove potentially inattentive participants using the total survey time.[5] Participants who rushed through the survey in under 200 seconds, or who spent over 3000 seconds were removed prior to analysis. Hence the final dataset consisted of 365 participants (190 female, 3 other / not declared; 69.3% of them were aged 18–26, 22.7% were aged 27–35, and 7.9% were older than 35). Some small sample of these participants had missing data in the additional measurements, i.e., CRT or the BNT ($n = 36$). It was decided to use their responses in the main analysis, but not to include them in the exploratory analysis. Despite the reductions, our sample size was 50% larger than the original and provides 80% power to detect between-subject effect sizes as small as $d = 0.26$.

3.2. Materials

3.2.1. Escalation of commitment

Participants read a vignette taken verbatim from Staw (1976). Participants were to imagine they are responsible for an investment decision in a company. The company is suffering a decline in income and company directors decided to try to improve its financial situation by allocating additional resources to development of either Consumer or Industrial Products.

In one condition participants were presented with declining income generated by the two products and were asked to decide in which product to invest (personal responsibility condition). In the other condition, participants read that another person decided to invest in one of the two products (no personal responsibility condition).[6] Next, participants were presented with the changes in income of the two products over five years after the decision was made.

Regardless of which product was chosen in the first part, half of the participants were instructed that the product selected to receive the initial investment had begun turning a profit while the unselected product continued to generate a loss. The other half of the participants were told the opposite: the product selected to receive the initial invested had continued to generate a loss while the unselected product had become profitable.

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[5] This decision seemed to be justified given the extremely wide range of survey time (range 35–177543 seconds, Median = 705, Mean = 1664, SD = 9712). After exclusions, the range was 202–2996 seconds, Median = 739, Mean = 869, SD = 507, retaining similar median, but shrinking the standard deviation around the mean.

[6] In the original study participants in high responsibility condition were also asked to briefly justify their decision to allocate resources into consumer or industrial products. Because the focal hypothesis never discusses the importance of explicit justification of the prior decision this part was omitted. Moreover, having participants justify their prior choice confounds escalation of commitment with the effects of elaboration which improves the memory of the focal information (Craik & Lockhart, 1972).

With this information, the participants were then told that another investment decision must be made. This time with a budget of $20M the participants were instructed to allocate the funds between the products in any manner they so wished. To provide their allocation, a slider was provided with $1M increments which could be moved to adjust the relative allocation between the two products (e.g., $4M to "Consumer Products" and $16M to "Industrial Products").

3.2.2. Cognitive reflection

Cognitive reflection was assessed using the original version of the Cognitive Reflection Test (Frederick, 2005)[7]. The test consists of three mathematical questions each with a strong, intuitively appealing but incorrect response. For example, people are asked:

A baseball bat and a ball cost $1.10 together, and the bat costs $1.00 more than the ball, how much does the ball cost?

To correctly answer "five cents" one often has to inhibit the intuitive response of "10 cents" that so easily comes to mind.

3.2.3. Numeracy

Numeracy was tested using an open-ended 4-item version of the Berlin Numeracy Test (Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012). The task requires mathematical calculations, but in contrast to the CRT, does not have intuitively appealing but incorrect responses. An example item is:

Imagine we are throwing a five-sided die 50 times. On average, out of these 50 throws how many times would this five-sided die show an odd number (1, 3 or 5)?

4. Results

Before conducting the primary analysis, we first tested for existing bias toward the two possible products. This was conducted to ensure that people did not consider either industrial or consumer products a more worthy investment regardless of the context. As expected, no evidence was found that participants were allocating funds more to one type of product than the other, $t(359) = -1.44$, $p = 0.150$. Therefore, no exclusions based on bias were necessary. Then we tested for the presence of escalation of commitment.

Contrary to the original experiment, no support for escalation of commitment behaviour was found (see Figure 1). As can be seen in the 2 · 2 ANOVA

[7] Despite the widespread familiarity with the CRT its score is most likely not improved through multiple exposures (Meyer, Zhou, & Frederick, 2018). Even if the scores on the test do improve overtime, the predictive power of the CRT is not diminished by this (Białek & Pennycook, 2018).

results in Table 1 it was found that a main effect of feedback was such that participants allocated more resources into successful projects compared to unsuccessful projects. This result is consistent with Staw (1976). However, no main effect of personal responsibility was found. Participants allocated funds to each project similarly regardless of whether they had personally made the initial decision to invest or not. Also, no evidence for a feedback · personal responsibility interaction was found. Neither of these results are consistent with Staw (1976) and, most importantly, the lack of interaction suggests that the participants were not investing the most after receiving negative feedback on a product that they had originally decided to invest into.

Table 1. Results of the ANOVA

Predictor	$F(1, 357)$	p	$\eta^2 p$
Personal responsibility	0.05	0.828	0.000
Feedback	5.69	0.018	0.016
Personal responsibility & feedback	0.15	0.704	0.000

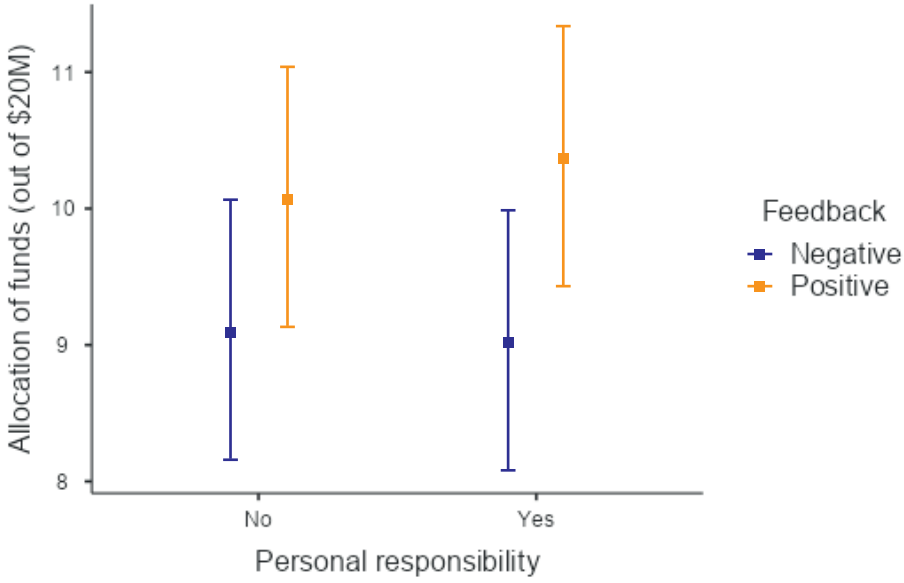

Figure 1. Allocation of funds depending on feedback and personal responsibility

Note: Personal Responsibility refers to whether the participant made the initial investment decision or not. Feedback refers to whether the previously chosen product performed better or worse compared to the alternative product. Error bars represent 95% Confidence Intervals.

Source: Own work.

One concern is that the observed pattern of results could be the product of participants who were lacking motivation due to a lack of fiscal incentive. If this were to be the case, it might be expected that participants would just simply divide the resources between the two products equally. That is, spending \$10M to develop each of them further. However, only 40 individuals (11.1%) allocated the funds in this manner. This suggests it is unlikely that the failure to reproduce an escalation of behavior effect was due to a lack of motivation. Furthermore, when the 40 individuals are removed from analyses, the results are nearly identical to what is reported in Table 1.

Next it was explored as to whether individual differences in numeracy (BNT score) and in cognitive reflection (CRT score) can help explain the observed pattern of results. As evidenced by Table 2, none of the covariates produced a significant main effect, and the remaining effects were largely identical. That is, no evidence was found that escalation of commitment is affected by numerical or reflective ability.[8]

Table 2. Results of the ANCOVA

Predictor	$F(1, 321)$	p	$\eta^2 p$
BNT	1.41	0.235	0.004
CRT	0.82	0.366	0.003
Feedback	5.54	0.019	0.017
Personal responsibility	0.01	0.930	0.000
Feedback & Personal responsibility	0.01	0.934	0.000
Personal responsibility & BNT	0.09	0.770	0.000
Personal responsibility & CRT	0.09	0.767	0.000

Source: Own work.

Conclusions

The present work aimed to replicate the seminal finding of escalation of commitment as first reported by Staw (1976) and further extend this work by examining potential cognitive mechanisms underlying the effect. Similar to

[8] Performance on both the BNT ($M = 1.81$, $SD = 1.28$) and CRT ($M = 1.95$, $SD = 1.12$) was similar to that reported in prior experimental work (see Białek & Pennycook, 2018, for overview) and the oft observed correlation between the two measures was also observed here, $r(327) = 0.53$, $p < 0.001$ (e.g., Białek, Bergelt, Majima, & Koehler, 2019; Cokely et al., 2012). Therefore, the lack of associations between numeracy and escalation behaviour, and reflective ability and escalation behaviour do not appear to be the product of measurement error or inattentive participants.

prior research that has revealed difficulties in replicating sunk cost effects (e.g., Armstrong et al., 1993; Friedman et al., 2007; Negrini et al., 2020, but see Ronayne, Sgroi, & Tuckwell, 2021 for a successful replication) no evidence of escalation of commitment behaviour was found. That is, undergoing the same procedure and materials (translated into Polish) as Staw (1976), participants on average allocated a similar amount to each product even when they had made an initial decision to invest in a product that had since continued to fail. It was also not found that escalation of commitment behaviour varied as a function of ability to process numerical information or willingness to engage in cognitive reflection.

The lack of observed effect of personal responsibility, the primary result of interest in Staw (1976), can be interpreted as if participants were indifferent about whose choice it was that led to the situation faced. It is possible that this might reflect "inheritance" of commitment or perhaps as "interpersonal escalation of commitment". Parallel to the interpersonal sunk cost effect (Olivola, 2018), participants may have treated another's previous decision as if it were their own. For instance, people were more likely to continue eating a bland cake that they themselves did not bake only because someone else had invested time, effort, and money into doing so. While such an account is plausible, if this were to explain our findings, then it would be expected that participants would allocate more funding to the failing project than the successful one. No evidence in support of this possibility was found. Instead, evidence was found for an effect in the opposite direction: participants were more willing to invest in a successful rather than failing project. Therefore, it is not believed that the results reflect some sort of interpersonal escalation of commitment, but rather demonstrate a well-powered failed replication attempt of the work by Staw (1976).

Little evidence was found that escalation of commitment is predicted by numerical processing ability or willingness to engage in cognitive reflection. It could be argued that because ample examples of escalation of commitment were not found that the required variance between individuals to be able to examine individual differences was not present. So, despite the observed lack of correlation, numeracy and cognitive reflection may still explain escalation of commitment behaviour because it is not possible to so determine. However, if low numerical ability predicts a greater tendency to escalate commitment, then the inverse is likely also true: high numerical ability predicts a greater tendency to de-escalate commitment. Failing to detect any part of this relationship suggests individual differences in the tendency to escalate commitment are not associated with differences in numeracy or cognitive reflection. Based on this, a tendency to escalate commitment may have little to do with an individual's reflective (Type 2) processing and may be the consequence of an individual's intuitive (Type 1) processing. While future work should look to test this possibility, the claim is in line with recent work demonstrating

that on several commonly used stimuli in the reasoning world, differences in intuitive processing explain most of the differences in correct responding (Raoelison et al., 2020).

Despite the published record of escalation of commitment effects (Sleesman et al., 2018) it is suggested that future research look to conduct well-powered replications of such phenomena. While this study cannot represent a successful replication of the original work by Staw (1976) the sheer lack of any supportive results casts some doubt on the legitimacy of such a long-standing effect. However, it is suggested that this work serve only as a potential catalyst for deeper examinations into the strength of escalation of commitment and of its boundary conditions. It is also suggested that future research continue to test whether cognitive mechanisms, particularly under a dual process framework can help explain individual differences in the tendency to escalate one's personal commitment in response to negative feedback.

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