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Investigating Cognitive Foundations of Inertia in Decision-Making

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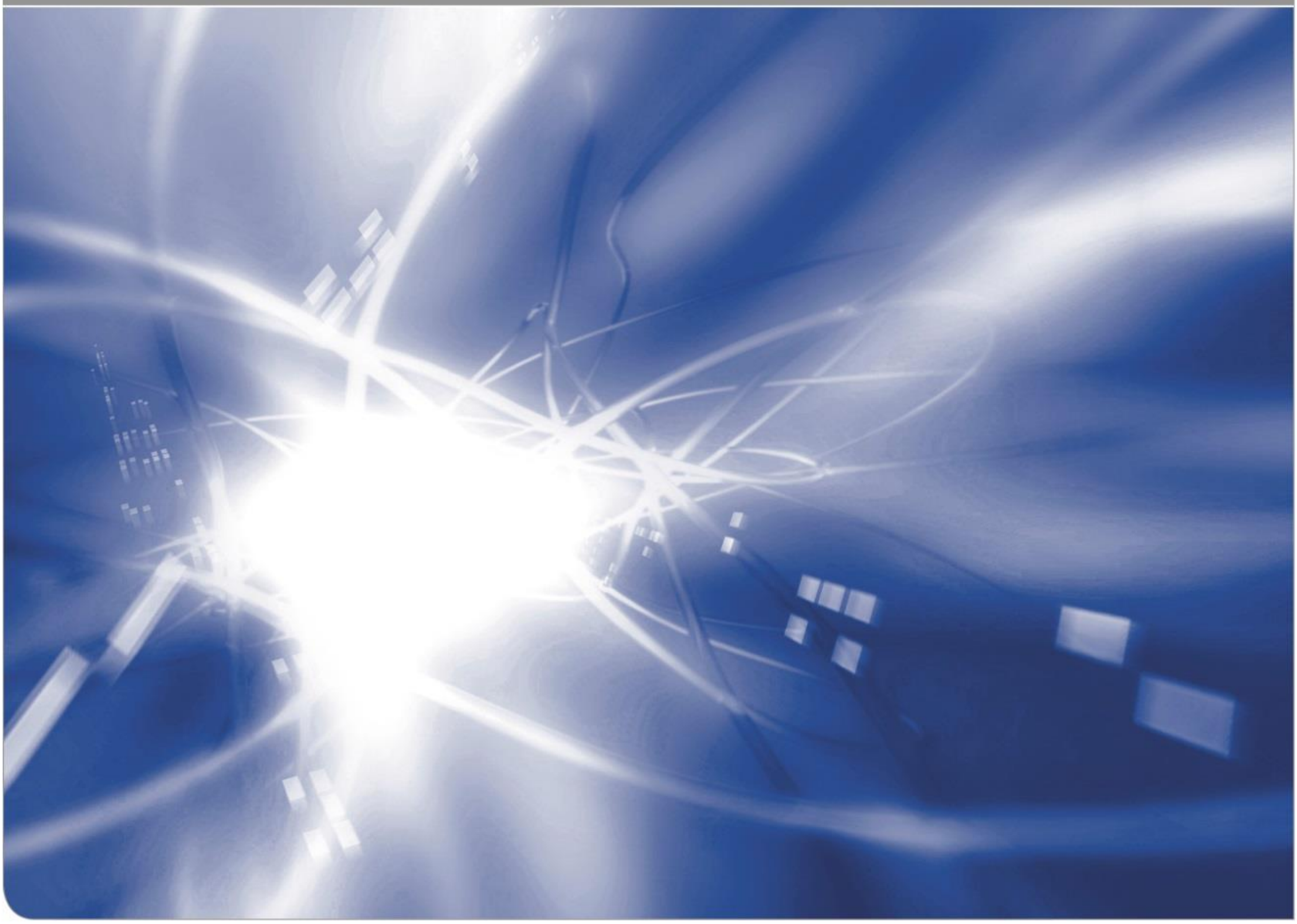

Investigating Cognitive Foundations of Inertia in Decision-Making

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Abstract: *Understanding the cognitive foundations of decision inertia plays a relevant role in modelling choice behaviour and designing decision support systems. The aim of this study was to investigate mixed findings regarding the influence of framing on the tendency to rely on previous decisions (decision inertia). Furthermore, we hypothesized that inter-individual differences in cognitive reflection, and in abilities of correctly processing Bayesian Information could be further relevant drivers of the inertia phenomenon. A dual-choice belief-updating task was conducted in the laboratory to investigate our hypotheses. Our results showed a significant association of faith in intuition, but no influence of framing or skills in Bayesian Updating. This indicates that existing explanations of decision inertia are not as robust as assumed.*

Keywords*: Decision inertia, Bayesian Updating, Framing, Faith in Intuition*

1 Introduction

Decision inertia, or the tendency of decision-makers to repeat a previous choice regardless of whether it was advantageous or disadvantageous (Alós-Ferrer, Hügelschäfer, & Li, 2016; Dutt & Gonzalez, 2012; Sautua, 2017) is a well-known phenomenon in judgement and decision-making research (Erev & Haruvy, 2013). Numerous studies demonstrate that decision inertia explains many decision-making anomalies and suboptimal economic decision-making such as disadvantageous economic belief-updating (Alós-Ferrer et al., 2016; Charness & Levin, 2005), suboptimal investment decisions (Sandri, Schade, Musshoff, & Odening, 2010), or the competitive sale dilemma (Liu, 2017).

However, there remains a need to get a better understanding of the cognitive processes driving this behaviour (Akaishi, Umeda, Nagase, & Sakai, 2014; Alós-Ferrer et al., 2016; Jung & Dorner, 2017). Understanding the drivers of decision inertia plays an important role in modelling choice behaviour and learning (Dutt & Gonzalez, 2012). Furthermore, this knowledge allows identifying situations where decision inertia is likely to occur, and providing the theoretical foundation to derive countermeasures to reduce decision inertia.

In a recent study, Alós-Ferrer et al. (2016) showed that consistency-seeking is an important precursor of decision inertia in decision making. In their tasks, participants with high preference for consistency tended to repeat the previous decision regardless of the consequences and even if the outcome was suboptimal. In further a study Alós-Ferrer et al. linked a situational-induced prevention focus to suboptimal belief-updating (Alós-Ferrer, Hügelschäfer, & Li, 2017). In their setting the decision task was framed in a win/loss frame by providing feedback in a success/failure format and the error rates of the participants in a dual-choice belief-updating task were compared. Other findings considering especially the tendency of decision-maker to repeat behaviour, provide evidence that regulatory focus is a relevant driver of choice repetition, regardless of whether it was situational induced, or whether the participants had a personal predisposition for it (Zhang, Cornwell, & Higgins, 2014). However, in contrast to the former, their studies did not find an influence of preference for consistency on choice repetition. Other studies even found a negative influence of prevention focus on decision repetitions in a moral task (Welsh, Ordóñez, Snyder, & Christian, 2015), a result that directly conflicts with Zhang et al.'s observation.

To this end, there exist mixed findings concerning the drivers of this phenomenon (see Erev & Haruvy, 2013; Jung & Dorner, 2017 for a review). In particular, the influence of regulatory focus on decision inertia remains unclear. In this work we seek to clarify the relationship between decision inertia, and framing-induced regulatory focus in more detail. Our hypothesis is that decision inertia does not only depend on the induced, situational regulatory focus of the task (e.g. by feedback framing), but rather on the individual and inherent capabilities to process Bayesian information correctly, and differences in cognitive reflection This includesthe tendency to rely on cognitive short-cuts or intuitions to avoid effortful deliberative processes like Bayesian processing by relying on decision inertia. Consequently, this rationale could explain the mixed findings concerning the influence of regulatory focus or framing on decision inertia. For instance, if a decision maker has low capabilities in processing the information of a decision correctly, and if he is faced with a task inducing a situational regulatory focus, his tendency to rely on suboptimal decisions like decision inertia will be increased regardless of the framing. Consequently, we argue that individual cognitive capabilities and characteristics of the decision-maker are as important as the framing of the decision to understand the occurrence of decision inertia.

In our study, we aim to provide further insights into what drives decision inertia, manifesting as repeated decisions in subsequent decisions-making regardless of the consequences (Alós-Ferrer et al., 2016). In particular, we investigate decision inertia by employing a neutral belief-updating task in a controlled lab environment. In the laboratory setting, we can compare different context conditions and measure the influence of possible drivers of decision inertia objectively. In doing so, we focus on three possible drivers of inertia in decision-making: capabilities in Bayesian Updating, faith in intuition, and situational induced regulatory focus. In particular, regulatory focus has been discussed as a possible driver of decision inertia in the recent literature, albeit with conflicting results (Alós-Ferrer et al., 2016; Welsh et al., 2015; Zhang et al., 2014). Thus, there remains a need to clarify the role of regulatory focus. To this end, we face our participants with a subsequent decision task in which decision inertia can be objectively measured (Jung & Dorner, 2017). Following the paradigm of these tasks, decision inertia occurs, when a participant repeats a previous decision regardless of the consequences, resulting in a suboptimal outcome. This kind of experimental operationalization is a common format to measure decision inertia and has been replicated in various studies (see e.g. Alós-Ferrer et al., 2016; Charness & Levin, 2005; Geller & Pitz, 1968; Pitz, 1969).

We have organised this paper as follows. In the next section, we introduce our theoretical background and develop our research hypotheses. Thereby, we incorporate recent findings on repeated decision-making and decision inertia. We then continue with describing our research design and findings. In the last step we discuss our results, and end with the conclusion, suggestions for future research and discuss limitations of our study.

2 Decision Inertia in Decision-Making

It is generally accepted that decision-making is affected by an interaction of multiple cognitive processes, in particular of parallel-competitive processes, which can converge or diverge and affect our intention (Alós-Ferrer & Strack, 2014; Dhar & Gorlin, 2013; Strack, Werth', & Deutsch, 2006). It is the outstanding contribution of these models that they allow to combine the existing findings of rational choice with findings about systematic deviations (biases) from economic rationality. Following this rationale, Alós-Ferrer et al. conceptualize decision inertia as the result of a cognitive process that may or may not diverge from other deliberative processes and influences decision outcomes and decision times (Alós-Ferrer et al., 2016, p. 2). This conceptualization suggests that decision inertia can be in line with optimal behaviour, but it does not necessarily have to be. This is a relevant aspect, because choice repetition per se is not irrational. For instance, if decision-makers assume lower expected utility of the alternative choice option, or if they fear to be blamed for the decision (Steffel, Williams, & Perrmann-Graham, 2016), they behave optimally from a subjective-view if they rely on decision inertia.

In our work, we consider this by building our research on the two-draw-paradigm (Achtziger, Alós-Ferrer, Hügelschäfer, & Steinhauser, 2015; Alós-Ferrer et al., 2016; Charness & Levin, 2005) that includes two treatments where choice repetition is suboptimal or optimal, respectively. In particular, this allows us to compare drivers of decision inertia, the tendency of decision-makers to repeat decisions, regardless of the decision outcome.

2.1 Bayesian Updating (H1)

Following recent studies investigating decision inertia, we rely on a probability-updating task (Alós-Ferrer & Hügelschäfer, 2016). In this kind of task participants are repeatedly faced with situations where intuitive processing (e.g. decision inertia) and deliberative processing (e.g. Bayesian Updating) are convergent or divergent, which means that they prescribe similar or different behavioural responses. Or in other words, in series of two subsequent decisions, participants show the tendency to repeat the previous decision, without considering the new information and processing the correct Bayesian probabilities correctly (which is termed decision inertia). With this paradigm in mind, we argue that decision inertia could be also driven by poor skills in Bayesian Updating compared to other motivational explanations. Even if the error rates in the convergence and divergence situation differ significantly, we hypothesis that decision makers rely partly on decision inertia because the calculation of Bayesian probabilities is to effortful for them. Hence, we hypothesize that:

- **Research Hypothesis 1**: Poor skills in Bayesian Updating are positively associated with decision inertia.

2.2 Faith in Intuition (H2)

Furthermore, we assume that the tendency to rely on decision inertia is associated with the individual's tendency to use heuristic processing and cognitive shortcuts. For instance, biased decisions were associated with lower abilities in cognitive reflection (Hoppe & Kusterer, 2011), as measured by the cognitive-reflection test (Frederick, 2005). Alós-Ferrer and Hügelschäfer showed that high scores in the cognitive-reflection test are linked to overweighting of the sample information (Alós-Ferrer & Hügelschäfer, 2012). In a subsequent study, Alós-Ferrer and Hügelschäfer compared the influence of differences in intuitive-analytic cognitive styles of decision-makers on errors in probability judgments (Alós-Ferrer & Hügelschäfer, 2016). They found evidence for a relationship of the tendency to rely on heuristic decision-making and suboptimal probability processing. Following this rationale, we assume that:

- **Research Hypothesis 2**: Faith in intuition is positively associated with decision inertia.

2.3 Framing and Regulatory Focus (H3, H4)

Relying on regulatory focus and framing literature, we assume a relationship between a specific regulatory focus orientation and decision inertia. In particular, promotion focused individuals are more likely to behave more risky in memory classification tasks (Higgins, 1997). This is in line with Liberman et al., who showed that promotion-focused individuals are more likely to change a resumed task for a different task (Liberman, Idson, Camacho, & Higgins, 1999). They showed the same for changing an endowed object. Hence, promotion focused individuals have an openness to change and tend to change a previous decision even if the new situation does not explicitly represent a gain. This makes promotion-focused individuals persevere less in a previous decision, even if it had a positive outcome. This is in accordance with Friedman and Foerster, who showed that promotion-oriented individuals are more creative and tend to use less conservative strategies in order to come up with new ideas (Friedman, 2001). In a subsequent study, they could show a relationship of promotion-focus and less accurate but faster task performance (Förster, Grant, Idson, & Higgins, 2001), which should increase their error rates when Bayesian Updating is in line with decision inertia. On the other hand, considering prevention focus, Friedman and Förster found that prevention focus cues, i.e. cues that induce a prevention focus state, lead to a more risk-averse, less creative and hence a more perseverant processing procedure (Friedman & Förster, 2001). Specifically, they had participants think of as many ways of use for a brick that they can think of. They found that prevention-focused individuals used many exemplars that they had already used in a previous task or associated material and hence came up with less innovative, but more conservative ideas. Liberman et al. showed that prevention-focused individuals tend to resume with an interrupted task (Liberman et al., 1999), hence showing the tendency to stay with a previous choice. This is in accordance with Zhang et al. 2014, who showed that a prevention focus leads to a repetition of previous behaviour, even if it was unmoral.

As a consequence, we assume that promotion focused individuals will behave more exploratory and risky, while prevention focus individuals behave more conservatively and repeat a decision. Therefore, we argue that prevention-focused decision-maker should show more decision inertia (loss vs. non-loss framing), and promotion-focused decision-maker respectively less decision inertia (gain vs. non-gain framing).

- **Research Hypothesis 3**: A situational prevention focus (loss vs. non-loss) compared to a promotion focus (gain vs. non-gain) is positively associated with decision inertia

3 Methods

3.1 Experimental Design

In the current investigation we rely on the dual choice paradigm investigating decision inertia (Alós-Ferrer et al., 2016; Jung & Dorner, 2017; Pitz, 1969). This experimental task has been used reliably to induce decision inertia (e.g. Achtziger, Alós-Ferrer, Hügelschäfer, & Steinhauser, 2014; Charness & Levin, 2005). In this paradigm, participants are faced with two urns with each 6 balls that can each be black or white, and there are two different options of how black and white balls are distributed in the urns. 0 shows the two different states of the world – the two possible distributions – that the urns can have.

Table 1: Implemented lotteries of the urn game, based on (Alós-Ferrer et al., 2016; Pitz, 1969).

State	Left Urn	Right Urn
Up (p=1/2)	●●●●○○	●●○○○○
Down (p=1/2)	●●○○○○	●●●●○○

The states of the world are constant over two subsequent draws. After two draws, one of the states randomly is assigned anew. Whenever participants draw a black ball, they win EUR 0.10. In the standard version of this task, they don't lose anything when they draw a white ball, but they don't win anything either. Participants are asked to draw two times a ball with replacement. Note that the participants only know that there are two possible different states of the world, yet they do not know which of the two states is present. However, since the draw is with replacement and the state of the world is constant over the two-draw decision round, participants can calculate the probability of which of the states is more likely to be present. Obviously, there are straightforward optimal strategies how to react to each of the first draw's colour of the ball. Specifically, whenever the first draw is a black ball, it is rational to stay with the urn. Whenever it is white, it is rational to switch. This is due to Bayesian updating, which is a recalculation of new probabilities based on every new information cue. Decision inertia is measured as the individual tendency to repeat a previous urn, even if it would be optimal to switch to the other one (Alós-Ferrer et al., 2016; Jung & Dorner, 2017).

To compare situational regulatory focus, we had to implement a second variant of this experimental task. Hence, we framed the participants in two situations that were equivalent with respect to probabilities and objective outcomes (Otto, Markman, Gureckis, & Love, 2010; Shah, Higgins, & Friedman, 1998). Specifically, the framing of the urn game was changed to a loss framing vs. win framing oriented task, which has be done in a similar matter in previous studies (Alós-Ferrer et al., 2017). In the loss frame condition, participants received an initial endowment of EUR 0.20 for each two-draw decision set and lost EUR 0.10 when drawing a white ball. In the win frame condition, participants won EUR 0.10 when drawing a right ball without having an initial endowment. Furthermore, participants in the promotion condition received result messages like "You have won 0.10 MU" (MU: monetary units) or "You did not win 0.10 MU", and in the prevention condition they received result messages like "You have not lost 0.10 MU" or "You lost 0.10 MU". To compare the induced situational framing, we let the participants play each condition randomly (40 rounds promotion condition, then 40 rounds prevention condition, or in the other way round).

In the second step, the participants played one round of the Brown–Peterson distraction task (Peterson & Peterson, 1959) to avoid direct framing or memory effects, before they played the second version of our urn game. The distraction task took about 30 seconds, and the working memory of the participants is overwritten, while they are asked to remember two trigrams, while subtracting values from a number. A correct answer in the task was rewarded. Finally, the participants were faced with a variation of the urn game to measure their capabilities in Bayesian Updating (Alós-Ferrer & Hügelschäfer, 2012). In the subsequent urn game task, participants were faced with a sample of one of the urns drawn randomly from the computer. The participants had to guess the posterior probability that the sample was drawn from the urn with the majority of black balls. Correct answers (+/- 5 % error acceptance) were rewarded with a small monetary payoff at the end of the task. The participants had to give an answer after each round of sampling. To compute the skills in Bayesian Updating, we computed the mean deviation between the correct posterior probability and the estimates over all draws (difference between objective and subjective probability).

3.2 Participants

54 adult participants (30 male, 24 female, age range=17-30, M=21.74, SD=2.54) took part in the experiment at Karlsruhe Decision and Design Lab (KD2Lab). The participants were recruited from our student pool from the Karlsruhe Institute of Technology (KIT), and received a participation fee of EUR 2.00, a payment of EUR 3.00 for the questionnaire, and a performance-based payment of EUR 0.10 for each drawn black ball or correct answer. Mean payoff was EUR 10.85 (SD = 1.04). The knowledge quiz and the experimental tasks took approximately 30 minutes.

3.3 Procedure

To address our hypotheses, we carried out the following experiment, which consisted of three steps (see figure 2). Approximately 2 weeks prior to the experiment, participants registered for our experiment. Through registering for a specific time of their participation, they registered randomly for a treatment. After registering, they were asked to participate in an online questionnaire. They were told that they would receive 3€ at the day of the experiment for filling out the questionnaire until one week before, and showing up. In the questionnaire, we measured faith in intuition (Keller, Bohner, & Erb, 2000) and demographics. The online questionnaire was implemented in Limesurvey (Schmitz, 2012).

Figure 1. Experimental procedure consisting of two steps: an online, pre-experiment questionnaire, a break followed by the urn game and the Bayesian Updating task conducted in the laboratory.

At the day of the experiment, the participants were welcomed and after providing written consent, were provided with general instructions about the experiment. Before each task of the experiment, the specific instructions of the task were presented on the computer. Half of the participants were first provided with an introduction consisting of the urn game in a win frame, followed by the urn game in a loss frame. The other half of the participants got the same instructions, but in the opposite order. Before the experiment, the participants had to answer control questions to make sure they understood the general procedure of the experiment. The decision tasks (urn game and Bayesian Updating game) were prepared in our laboratory using a computer version of the experimental task as done by Alós-Ferrer et al. (2016). The computer version was implemented with Brownie (Hariharan et al., 2017) following the Brownie standard guideline for the design and implementation of computer-based experimental tasks (Jung, Adam, Dorner, & Hariharan, 2017).

3.4 Results

To measure decision inertia, we compare average error rates given divergence versus convergence between inertia and Bayesian updating (26.3%, SD = 24.9% and 7.4%, SD = 12.4%). Because of the non-normal distribution of error rates we relied on the non-parametric two-tailed Wilcoxon signed rank test, which indicated that the error rates in case of divergence were statistically significantly higher than in case of convergence ($n = 54$, $Z = 5.39$, $p \leq .001$, $r = .73$). Previous studies (Alós-Ferrer et al., 2016) report similar error rates, indicating that we could reproduce the inertia effect reliably in our setting.

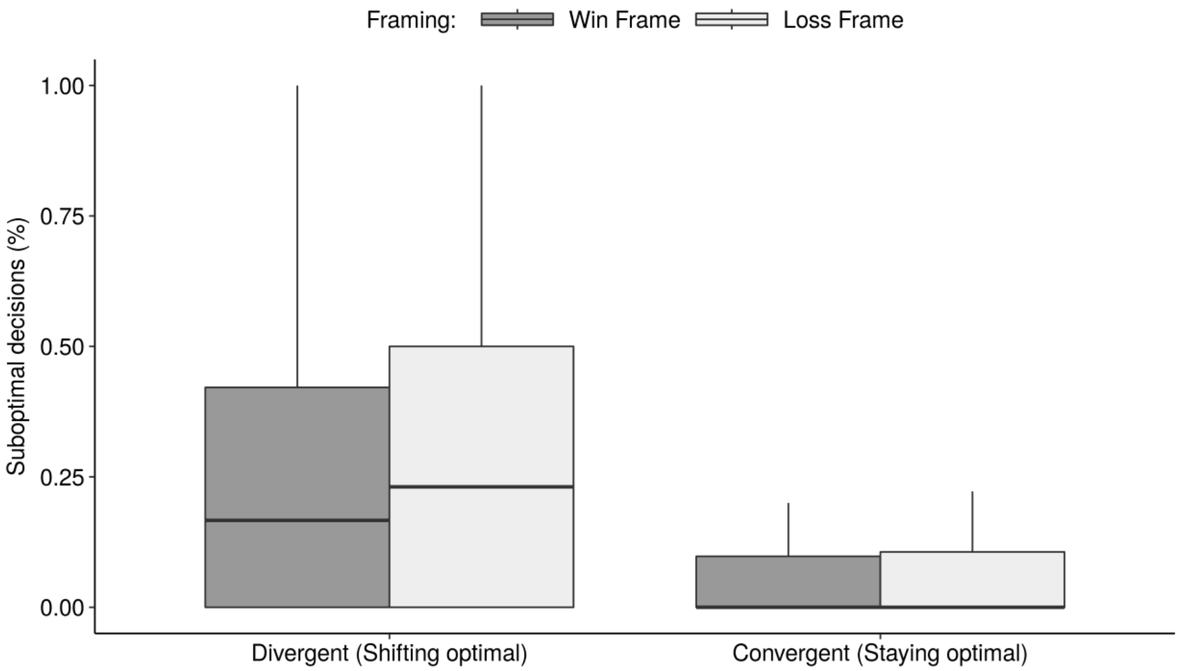

Figure 2 Error rates

Regarding error distributions at the individual level, we found inter-individual heterogeneity (Achtziger et al., 2015; Charness & Levin, 2005), best represented by two clusters of participants. Across both conditions, one big group of participants exhibited error rates above 25 per cent and one smaller group showed error rates of about 60 per cent. Similar results have been reported (Alós-Ferrer et al., 2016), indicating that the participants did not respond randomly, and that we could reproduce the decision inertia effect reliably.

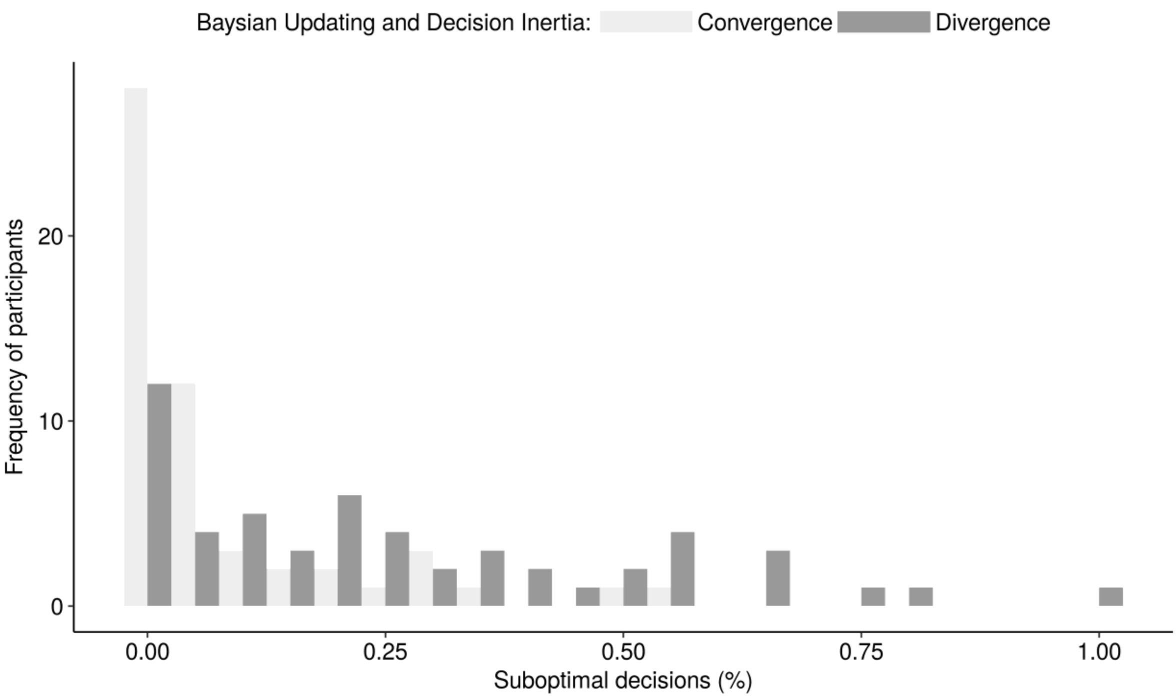

Figure 3 Distribution of the errors in the two-draw decision across the participants

To investigate the influence of the tendency to rely on intuitive processes on decision inertia, all participants had to complete a web-based questionnaire until one week before the experiment. In this questionnaire, we measured participants' faith in intuition beforehand (mean=3.3, SD=0.6, α=0.84). Furthermore, we standardized (z-transformed) all variables and run a random-effect probit regression on second-draw errors to investigate the relationships between skills in Bayesian Updating (H1), faith in intuition (H2), and framing (H3, H4). We conducted a random effect regression on suboptimal decisions to take the individual observations into account (see 0). To measure decision inertia, we considered situations were decision inertia was in divergence or converged with deliberative processing by adding a dummy variable (Divergence, 1=True). This procedure is a common approach to measure the influence of factors on decision inertia (see e.g. Alós-Ferrer et al., 2016; Charness & Levin, 2005). Additionally, this allows us to control for effects of gender and trial number (learning effects), and to compare factors influencing sub-optimal choices in general and decision inertia in particular (interaction with divergence=True).

Table 2**: Random-effects probit regression on errors (1=error)**

Variable	Beta (SE)	p
(Intercept)	-2.18	< 0.001 ***
Divergence (1=True)	1.07	< 0.001 ***
Framing (1=Loss, 0=Win)	0.28	0.03 *
Lack Of Bayesian Updating Skills	0.19	0.16
Faith in Intuition	-0.03	0.81
Trial Number	-0.03	0.41
Gender (1=Female)	0.36	0.14
Divergence x Framing (1=Loss, 0=Win)	-0.12	0.44
Divergence x Lack Of Bayesian Updating Skills	0.07	0.38
Divergence x Faith in Intuition	0.20	< 0.01 **
Number of obs: 2160; **random effect**: participant id, **participants:** 54; **Tjur's D** = .27 **Signif. codes**: 0 '***' 0.001 '**' 0.01 '*' 0.05		

If we consider the direct effects on suboptimal decisions, we found a significant positive effect of framing on suboptimal decision-making, suggesting that participants with an induced prevention focus are more likely to make more suboptimal decisions in the urn game. The significant influence of divergent processes shows that divergence of cognitive processes increases suboptimal decisions (decision inertia). However, we found no significant effect of Bayesian Updating skills or faith in intuition on suboptimal decision-making in our task. If we consider the drivers of decision inertia, by considering the interaction effects of process divergence with our three other factors, our results show a significant effect of framing of individual's tendency to rely on heuristic processing (faith in intuition), but no significant effect of skills in Bayesian Updating or loss framing.

3.5 Discussion

Our regression analysis shows a significant positive effect of the interaction of faith in intuition and divergent processes, supporting our assumption that decision inertia is driven by individual's tendency to rely on heuristic processing (H2). However, we found no significant effect of Bayesian Updating skills (H1) on errors in our task, indicating that the decision-making errors in our tasks are not due to participants' inability to understand or process the statistical rationale behind it. Consequently, decision inertia seems to occur independent of the statistical knowledge or skills of the decision-maker.

In contrast to our H3 and recent research investigating the influence of regulatory focus on belief-updating and choice repetition, we found no significant relationship between framing and decision inertia. However, our results suggest that loss framing increases the tendency to make suboptimal subsequent decisions, but not to rely on decision inertia in particular. We conclude that a loss framing might be linked to a more explanatory decision-making style; however it does not directly influence the tendency to rely on heuristic processing in particular.

4 Conclusion

Prior work has reported motivational factors like preference for consistency or regulatory focus as possible drivers of decision inertia and errors in subsequent decision-making. For instance, Alós-Ferrer et al. (2016) reported a significant influence of consistency-seeking on decision inertia. Other work, in contrast, declined the influence of consistency-seeking and proposes regulatory focus as a powerful predictor of decision inertia instead (Welsh et al., 2015; Zhang et al., 2014). However, these studies have not considered cognitive limitations as additional explanations of decision inertia and provided mixed results. In this work, we focused to clarify the relationship of decision inertia, regulatory focus and cognitive drivers in a belief-updating decision task.

We found a significant influence of regulatory focus on suboptimal belief-updating, but no significant influence particularly on the tendency to repeat a subsequent decision, regardless of the outcome. However, our results suggest a relationship between faith in intuition and decision inertia. Consequently, decision inertia could be driven by individual's general tendency to rely on heuristic processing additional to existing cognitive or motivational explanations.

These findings extend existing decision inertia and choice repetition research, confirming that situational induced regulatory focus due to framing can lead to suboptimal behaviour in subsequent decisions, even if it might have no influence on decision inertia. Additionally, our findings showed that decision inertia can be reproduced reliably in the lab, and is unrelated to gender, as it has been assumed in previous studies (Charness & Levin, 2005). Our results suggest that decision inertia is not influenced by decision framing, or individual differences in the ability of correct Bayesian Updating, but by faith in intuition. Based on our results, and complementary evidence from recent studies, we conclude that the influence of framing on inertia in decision-making is not as robust as assumed in previous choice repetition and belief-updating studies (Alós-Ferrer et al., 2017; Welsh et al., 2015; Zhang et al., 2014).

Further work is therefore needed to gain a better understanding of the cognitive foundations of this phenomenon, and to find interventions to overcome inter-individual differences in relying on decision inertia. Since decision inertia can lead to suboptimal decisions at both a personal and organizational level, it is important to further gain theoretical knowledge about the concept of decision inertia. With that knowledge individuals and organizations can be nudged or de-biased to make better choices. Specifically, consumers may consume or avoid products and services that are suboptimal or optimal for them. This also can be true at the organizational level, where companies use suboptimal strategies, processes, architectures, input factors and investments.

5 Literature

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