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Brief report

What are you calling intuitive? Subject heterogeneity as a driver of response times in an impunity game☆

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ABSTRACT

Studies on the intuitive or deliberate nature of human actions often use time constraints for identification, assuming that constrained individuals fall back to intuitive behavior. This identification strategy disregards individual heterogeneity and self-priming, i.e. the behavioral rule that subjects can form during the instructions phase, and then apply irrespective of the time constraint. We use respondent data from an impunity game as an example of how subject heterogeneity can drive results. 24 respondents face 240 more or less unfair allocation proposals out of a small or large pie and can accept or reject the offer. Upon rejection respondents burn their own money, but not the proposer's. Respondents decisions are communicated to the proposer. On average, emotional rejections take longer than deliberate acceptances. Including individual heterogeneity, though, we find that subjects who mostly accept (reject) take more time to reject (accept). Faster decisions are the ones conforming with the modal early reaction. We attribute this finding to heterogeneity in self-priming. Since self-priming is orthogonal to time constraints, it has the capacity to invalidate their use in the identification of dual decision modes.

1. Introduction

The widespread recognition of dual decision processes in economic and social choice (Kahneman, 2011) has led to a debate around which social decisions are intuitive and which are deliberate. The Social Heuristic Hypothesis (SHH, Rand et al., 2014), claims cooperation to be intuitive, while the perusal of selfish objectives would require deliberation. The SHH has been supported by studies in the realm of cooperation (Rand, 2016), honesty (Capraro, 2017), reciprocity (Hallsson, Siebner, & Hulme, 2018) and altruism (Rand, Brescoll, Everett, Capraro, & Barcelo, 2016). However, the SHH has been challenged by studies and meta-analyses which do not support the intuitive nature of cooperation (Alós-Ferrer & Garagnani, 2020; Bouwmeester et al., 2017; Kvarven et al., 2020; Tinghög et al., 2013).

In most SHH studies, 'intuitive' is identified via time constraints, cognitive load, ego depletion, or procedural priming (for a review, see Capraro, 2019). A time-constrained (cognitive loaded, depleted, appropriately primed) individual is assumed to rely

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more on intuitive, System I than on deliberate, System II cognitive strategies. While largely adopted, such experimental designs do not guarantee the expected identification for two main reasons.

First, most studies rely on exogenously fixed limits or tasks without taking into account subjects' heterogeneity. The same, say, time limit can allow some subjects to make a System II response but be a strict constraint for others. Subject heterogeneity is an important moderator in interpreting the results from such experiments (Alós-Ferrer & Garagnani, 2020) and to explain differences in response times in cooperation (Andrighetto, Capraro, Guido, & Szekely, 2020).

Second, individual self-priming can incapacitate the constraints. Self-priming means that during the instruction phase subjects can devise a rule to navigate the experimental task, which they apply during the experiment, irrespective of the constraints imposed. This rule can be of either intuitive or deliberate nature.

Our study contributes to the debate on intuitive *vs.* deliberate reactions in games by focusing on the role of heterogeneity and self-priming. We employ a non-private impunity game (Bolton & Zwick, 1995) with unfair offers. Proposers split a pie between themselves and a respondent with all possible splits favoring the proposer. Respondents have choice and voice, but no punishment power. They can only accept or burn what is offered to them to express their disapproval thus facing a conflict between an emotional response and monetary opportunism. Evidence from related ultimatum experiments, across different designs involving time pressure and delays, shows that rejecting offers is on average more 'intuitive' than accepting them (Cappelletti, Güth, & Ploner, 2011; Ferguson, Maltby, Bibby, & Lawrence, 2014; Grimm & Mengel, 2011; Neo, Yu, Weber, & Gonzalez, 2013; Sutter, Kocher, & Strauß, 2003). But these designs usually do not take into account what subjects have planned to do after reading the instructions, a plan to which we refer as self-prime.

To account for individual heterogeneity in self-priming and analyze in depth the strategies of respondents while avoiding deception, our study employs two different laboratories. We first collected 240 offers from proposers in a computer laboratory. Proposers could offer one of three more or less unequal splits from a small or large pie. When deciding, proposers knew that respondents in another lab would participate at a later time and that they would learn their matched respondent's reaction by email. We then collected replies to *each* of the 240 proposals from 24 respondents in an fMRI laboratory. Respondents had up to two seconds to resolve the conflict whether to opportunistically accept or to reject the offer. Both inclinations can continually vary in strength, allowing their relative importance to be measured via response times (see Krajbich, Bartling, Hare, & Fehr, 2015; Moyer & Landauer, 1967, for discussions on how the strength of inclinations can affect decision time). We study variations along this continuum due to different parameters (the pie size and the offered amount) and participant heterogeneity.

The fMRI setting allowed us to collect 240 successive responses without using the strategy method and to track decision times to the millisecond with full attention and no confounds. We explore the choice and decision times dynamics as subjects reply to each offer and thereby learn across time the distribution of offers. Unlike what seems customary in fMRI experiments we do not deceive respondents: each offer they see is real, and they know that their individual replies will be notified to ten randomly matched proposers.

Our findings strongly suggest that what is 'intuitive' for subjects depends on their type, possibly via self-prime. Proposers tend to offer minimal shares irrespective of pie size, which respondents overwhelmingly reject, while mostly accepting larger offers. In contrast with nearly every study of negative reciprocity in ultimatum experiments (see the review of Capraro, 2019) and impunity (Takagishi et al., 2009), in our data (emotional) rejections take on average *longer* than (deliberate) acceptances. But average results are entirely driven by subject heterogeneity, similarly to the findings of Andrighetto et al. (2020) and Alós-Ferrer and Garagnani (2020). We classify subjects in three types: Opportunistic, who (nearly) always accept all offers; Fairness-minded, who reject lowest offers irrespective of the pie size; and Monotonic, who more likely reject unfair offers from the larger pie. Response times follow closely the behavioral types, and type-specific behavior stabilizes after a handful of decisions. Subjects who accept more often in the very first decisions take less time to accept, while subjects who reject more often in early decisions take less time to reject.

Our results cast doubt on the use of time constraints as a device to identify *average* 'intuitive' behavior, as largely done in the literature discussing the Social Heuristic Hypothesis. We show that one's self-prime, i.e., the choice which one has come to prefer after reading the instructions, consistently affects response times. Constraining response time mainly constrains the subject to this 'default' choice. But this default seems to depend more on the subject type or self-prime than on "intuitive" or "deliberate" considerations.

2. The impunity game

We study negative reciprocity via an asymmetric impunity game (Bolton & Zwick, 1995; Forsythe, Horowitz, Savin, & Sefton, 1994) where respondents have a choice and a voice. Proposers split a pie. Respondents can accept or burn their own money. This response is communicated to the proposer, who is monetarily unaffected, i.e., respondents have no sanctioning power. There is none of the strategic depth and behavioral nuances of ultimatum games but still an intuitive or deliberate response in an otherwise dictator-like allocation task.

We distinguish a smaller and a larger pie. The pie size is common knowledge to trigger differently strong emotions. Learning about the larger pie can raise hopes of receiving a large offer. Similarly, the same monetary offer can be seen as relatively generous (unfair) when coming from the small (large) pie.

Formally, let $p > 0$ denote the joint endowment — the pie. We exogenously fix a smaller ($\underline{p}$) and a larger ($\bar{p}$) positive pie. Proposers are randomly assigned a pie $p \in \{\underline{p}, \bar{p}\}$, and have to choose one of three unequal offers $y \in \{y_{low}, y_{medium}, y_{high}\}$, with $0 < y_{low} < y_{high} < \frac{1}{2}\underline{p}$. Then the respondent, after learning about the pie size p and the offer y, can accept, $\delta(y) = 1$, or not, $\delta(y) = 0$.

Table 1
Distribution of offers faced by respondents.

Pie Size	Offer		
	Small (1€)	Medium (3€)	Large (5€)
Small (11€)	80	32	8
Large (19€)	55	34	31

If the respondent accepts she receives y. If she rejects, then she does not receive any payoff. The proposer earns $p - y$ irrespective of $\delta(y)$. Finally, the respondents' decision is notified to the proposer via email. The monetary payoffs are:

$$\begin{cases} p - y & \text{for the proposer} \\ \delta(y) \cdot y & \text{for the respondent} \end{cases}$$

An opportunistic proposer, interested only in her own payoff, will offer the smallest positive amount. An equally opportunistic respondent would accept any offer. Behaviorally, however, one would expect embarrassingly low offers to be sometimes rejected (see Cooper and Kagel (2016) for a review).

We implemented the impunity game with the following parameters:

$$\underline{p} = 11€,\ \bar{p} = 19€,\ \text{and}\ \ y \in \{1€, 3€, 5€\}$$

All offers let respondents earn less than proposers. We chose absolute amounts to explore how respondents react to identical offers from different pies. We expected interpersonal and intra-personal heterogeneity in response decisions and response times as well as interpersonal heterogeneity in proposer behavior.

3. Experimental design

To avoid deception and cope with the technical requirements of fMRI experiments we elicited proposer and responder behavior in two different laboratories.

First, 240 proposers decided in a traditional incentivized laboratory experiment about their offer (1, 3, or 5 €), knowing the pie size (11 or 19 €) and that they would be notified later by email about the decision of their matched respondent. The experiment took place at the Max Planck Institute's experimental lab in Jena, Germany. It was programmed in zTree (Fischbacher, 2007), recruitment used ORSEE (Greiner, 2015). Screenshots and the English translation of the German instructions are available in the online Appendix. Mean proposer payoffs, including a 2.5 Euro show-up fee, were of 10.7€ for the small and 17.9€ for the large pie.

Later, 24 right-handed respondents took part in fMRI brain-scan experiments run in the BioPsy lab in Jena. Each respondent passed a medical screening, gave her informed consent, took a right-handedness test and was informed about the instructions of the game before entering the scanner. The response elicitation was divided into two parts, with a pause in between to let the participants get some rest. The lengthy procedure gave the subjects ample time to consider the game and engage in self-priming, i.e., figure out how to respond to pie sizes and offer amounts.

Each respondent faced choices by all proposers, in random order, but only 10 randomly picked proposals were payoff relevant. Each proposer's offer was payoff-relevant for exactly one respondent.

Respondents learned about the pie size and the offer and then had up to two seconds to react, using a two-button controller. Overtime choices were recorded as an error.

The experiment lasted on average 1 and a half hours. The respondent interface used visual stimuli identical to those used for proposers, available in the online Appendix. Average respondent payoff was 24.5€ including a 10€ show-up fee.

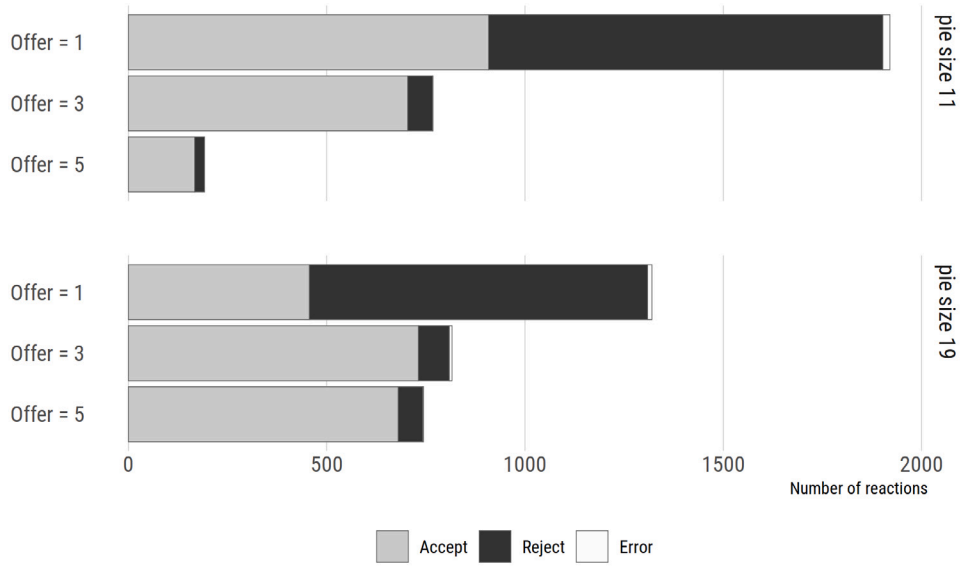
Our data comprises the allocation choices of 240 proposers as well as 240 response choices and decision times of 24 respondents.

4. Results

The full data and R scripts to reproduce all analyses can be found at the paper's OSF page https://osf.io/mf5nj/.

Proposals

Each respondent faced 240 proposals. Proposers offered significantly more 1€ than any other offer (Table 1). Offers differ by pie size. 1€ offers were more common from small, 5€ from large pies (Fisher exact test, p-value < 0.001), whereas the share of 3€ offers is virtually unchanged.



Pie size	Offer	Reject	Accept	Error	% Accept
11	1	994	908	18	47.73%
	3	63	704	1	91.79%
	5	25	167	0	86.98%
19	1	853	456	11	34.84%
	3	78	731	7	90.36%
	5	62	680	2	91.64%

Fig. 1. Distribution of reactions conditional on pie size and offer.

Distribution of responses

Fig. 1 and its related table report the distribution of responses, conditional on pie size and proposal. Offers of 3 and 5 € were overwhelmingly accepted, irrespective of pie size (Fisher exact test, 3€ offers, p-value = 0.33, 5€ offers, p-value = 0.052). Minimal offers of 1€ were more often rejected than accepted, with the rejection rate being markedly lower for offers coming from the small (52.3%) rather than the large (65.1%) pie (Fisher exact test, p-value < 0.001)

These results are biased by considering the 240 observations from each subject as independent and not taking into account heterogeneity in individual types and strategies. In particular for 1€ offers coming from either pie size, we next assess whether results are driven by heterogeneity *within* or *across* individual types, identified by how they solve the conflict between opportunism and intuitively voicing one's disgust.

Individual strategies

Fig. 2 plots the relative acceptance and rejection shares for each of the 24 respondents, for each pie size and offer. Respondents clearly differ in behavior and can be classified in three main types plus a residual category:

Opportunistic subjects (2, 12, 13, 20) accept any offer, irrespective of its amount and pie size.

Monotonically reacting subjects (3, 4, 5, 6, 17, 24) are more likely to reject offers when they come from large rather than small pies.

Fairness-minded subjects (7, 8, 9, 10, 14, 16, 18, 19, 21, 22, 23) always reject 1€ offers, irrespective of the pie size.

Residual subjects (1, 11, 15) more likely reject higher than lower offers or always reject.

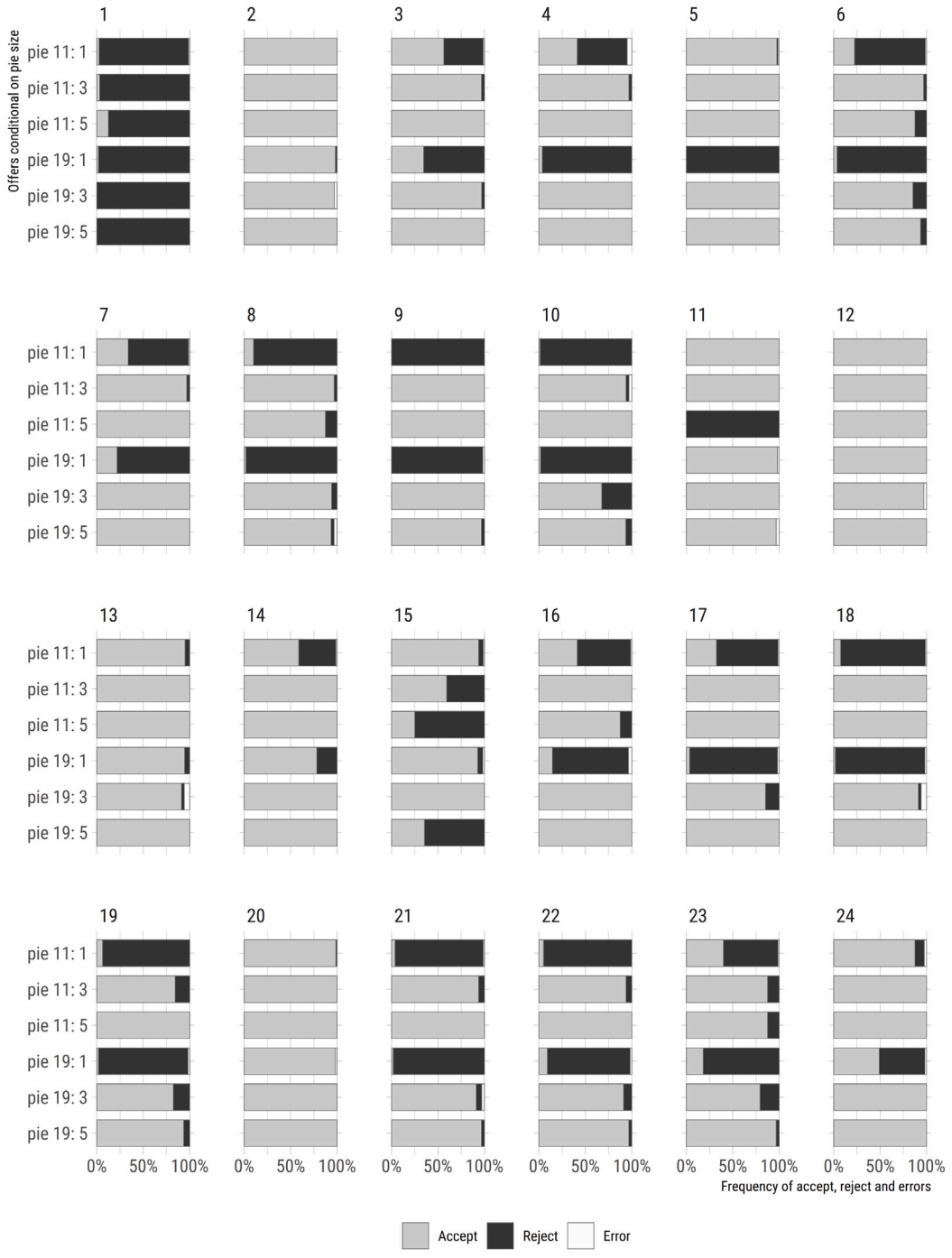


Fig. 2. Individual choice shares.

Fig. 3 visualizes the choice shares pooling subjects by type. Most heterogeneity regards 1€ offers. More than half of the 21 non-residual subjects are fairness-minded in the sense of often rejecting 1€ offers, and disproportionately so if coming from the large pie, while also rejecting to a lower extent 3 and 5€ offers. Monotonic subjects are a subcategory of fairness-mindedness: they unconditionally reject 1€ offers and seemingly trade off opportunism and desire to voice disgust.

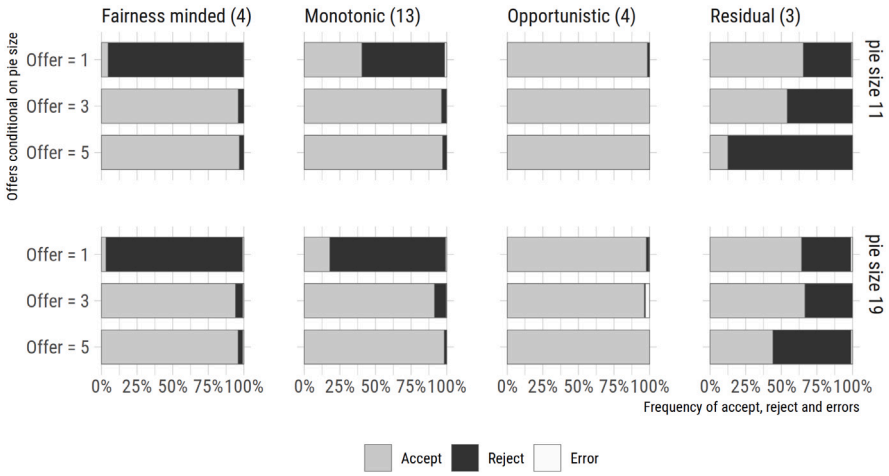


Fig. 3. Choice shares by behavioral type.

Table 2
Reaction time conditional on pie size and offer.

pie size	Offer	Reaction	Time	sd	N	p.value
all	all	Reject	673.08	255.85	2075	< 0.001
		Accept	595.59	265.69	3646	
		Error	0.00	0.00	39	
11	all	Reject	688.49	267.74	1082	< 0.001
		Accept	596.53	277.32	1779	
		Error	0.00	0.00	19	
19	all	Reject	656.28	241.24	993	< 0.001
		Accept	594.68	254.19	1867	
		Error	0.00	0.00	20	
11	1	Reject	688.19	258.86	994	< 0.001
		Accept	593.15	308.27	908	
		Error	0.00	0.00	18	
11	3	Reject	593.28	231.52	63	0.74
		Accept	603.63	242.91	704	
		Error	0.00		1	
11	5	Reject	940.51	477.55	25	< 0.001
		Accept	584.95	232.75	167	
		Error	–	–	0	
19	1	Reject	659.19	231.87	853	< 0.001
		Accept	578.86	277.84	456	
		Error	0.00	0.00	11	
19	3	Reject	628.47	294.44	78	0.60
		Accept	621.36	259.08	731	
		Error	0.00	0.00	7	
19	5	Reject	651.18	291.40	62	0.051
		Accept	576.62	228.92	680	
		Error	0.00	0.00	2	

Response time

We measured reaction time in milliseconds for each response. Subjects were not allowed to spend more than 2 s on each task. The choice environment was simple, the choice straightforward (accept/reject) and the visual stimuli reduced the time for information acquisition. Despite the short time, subjects did not seem overly constrained in their choice: only 0.67% of choices were submitted overtime (coded as an Error).

Rejections are significantly slower than acceptances (t-tests, p-values in Table 2). This is true overall, conditional on pie size as well as on pie size and offer, with no significance only for 3€ offers. This surprising finding is at odds with most of the literature from related ultimatum experiments, concluding that accepting requires a conscious effort of overcoming one's (instinctive) disgust and hence more time.

Table 3
Reaction time for each subject type.

Subject type	Overall	Acceptances			Rejections			t.test
	time	N	mean	sd	N	mean	sd	p.value
Fairness minded	675.35	423	710.91	230.42	532	653.42	218.41	0.00
Monotonic	652.28	1851	627.1	268.97	1245	702.29	268.39	0.00
Opportunistic	450.53	945	448.58	220.92	10	860.22	192.8	0.12
Residual	628.03	427	670.07	240.94	288	576.61	237.51	0.00

The general result hides type differences in reaction times for acceptance and rejection (Table 3). Opportunistic subjects, who always accept, do so significantly faster than fairness-minded, monotonic and residual subjects who reject (at least) some offers (t tests, all p-values < 0.001). Moreover, there is an inversion of the main time result across types. For fairness minded and residual subjects, acceptances take significantly longer than rejections; while for opportunistic and monotonic subjects, rejections take longer than acceptances (not significantly so for opportunistic types due to their extremely limited number of rejections).

This result can be explained by self-priming: devising a behavioral rule after reading instructions but before actually responding, possibly also during the first responses. The rule acts as a self-priming mechanism: following the rule is less time consuming than deviating from it. Such results are in line with decision conflict theory, which acknowledges competing drivers of decision making and relates decision time to the difficulty in overcoming the inner conflict between motives (see Capraro (2019) for a review and Andrighetto et al. (2020) for an application to cooperation showing similar results).

To test this explanation we analyze the relationship between individual acceptance rates of first responses – a proxy for the self-imposed behavioral rule – and the response time of acceptance and rejection, limited to offers of 1€, where there is enough variability in behavior.

We run a series of fixed effect panel regressions with standard errors clustered by subject. In each regression, we compute the initial acceptance rate over n responses (`%Accept(1:t)`) and use data for the remaining $N - n$ responses to estimate

$$\text{Response time} = \beta_0 + \beta_1 \text{Reaction} + \beta_2 \%\text{Accept(1:n)} + \beta_3 \text{Reaction} \times \%\text{Accept(1:n)}$$

We let n vary from 1 (the very first reaction) to 20 (the acceptance rate over the 20 first choices). The reference reaction is acceptance. Fig. 4 shows, separately for each pie size, the results for the two estimated parameters: `Reject`, measuring the difference in reaction time for rejections when `Accept(1:n)` is equal to zero, i.e. when subjects always reject in the first n responses, and `%Accept(1:n)×Reject`, measuring the impact of an increasing share of acceptances in the first n reactions on the time needed to reject. For the large pie, where there is more heterogeneity in replies and emotional responses play a more important role, data from the first 6 responses suffice to yield the significant results that subjects who never accept take less time to reject and that the higher the acceptance rate, the longer it takes to reject. The results for the small pie are qualitatively the same but do not reach significance.

5. Conclusion

We account for heterogeneity in response strategies and reaction time by differences in initially preferred responses, i.e., by heterogeneity in self-priming. Self-primed respondents face proposals with different intuitions and corresponding behavioral intentions. Following these intentions requires less time than deliberating whether to change course.

Response time is an important dimension of choice data, increasingly studied in experimental economics (Spiliopoulos & Ortmann, 2018) and recently shown to be crucial to uncover preferences from data in presence of uncertainty (Alós-Ferrer, Fehr, & Netzer, 2021). Nonetheless, our results show that using decision times for inference about the nature of behavior can be problematic since it does not take into account subject heterogeneity and self-prime. This result is similar in spirit to that of Krajbich et al. (2015), who show that the strength of preferences over stimuli can consistently bias response times, irrespective of decision modes. The neglect of individual heterogeneity and self-prime in several response time studies might also provide an explanation for the mostly null results of meta-analyses on the role of intuition and deliberation in social dilemmas (Kvarven et al., 2020) and altruism (Fromell, Nosenzo, & Owens, 2020).

The role of subject heterogeneity in response times has been highlighted before, for instance by Andrighetto et al. (2020) in social dilemma experiments, Alós-Ferrer and Garagnani (2020) in public good games and Teoh, Yao, Cunningham, and Hutcherson (2020) using eye-tracking. The main difference of our setup is that there is no dilemma: there exists an unambiguous best response when assuming monetary opportunism. Behaviorally, however, own monetary opportunism often conflicts with self-image or fairness concerns. Our experiment deals with subjects' inner individual conflict.

Our finding can hence be most appropriately accounted by decision conflict theory, which acknowledges competing drivers of decision making, e.g. when own monetary opportunism conflicts with emotions, self-image or social concerns. Decision conflict theory predicts heterogeneity in how strongly one is committed to self-primed opportunism, i.e. deliberated intention, and to the social and intuitive heuristic of expressing disgust when annoyed. Response times correlate with behavioral types, which likely result from self-imposed behavioral rules. So when accepting (rejecting) fast, this simply shows self-primed monetary opportunism (the need to voice own disgust), rather than shedding light on decision modes.

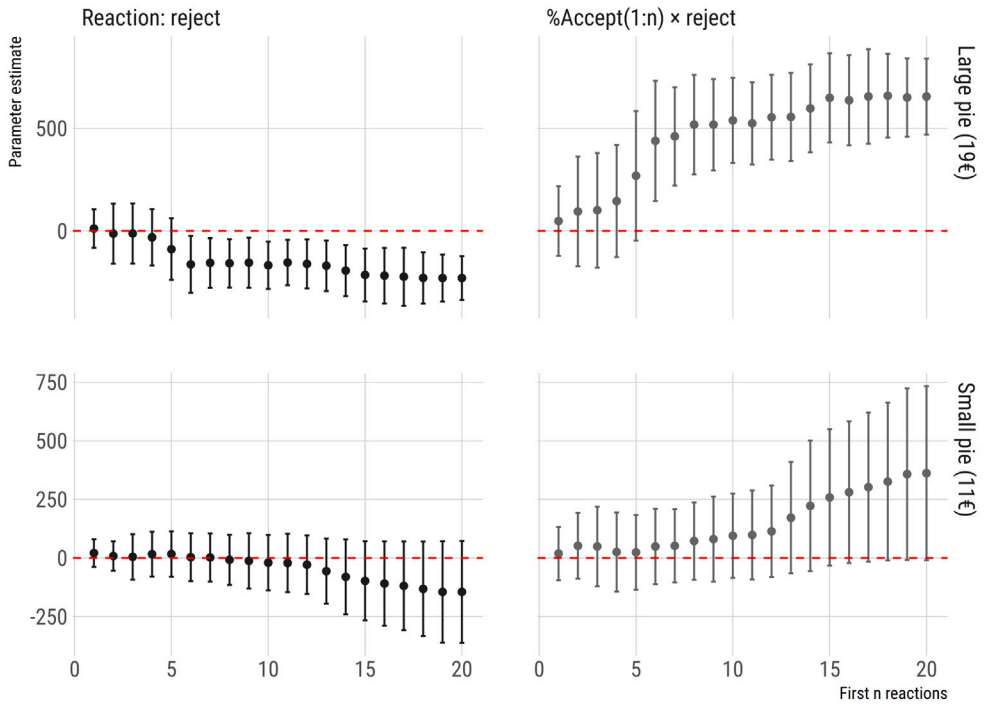


Fig. 4. Parameters estimates for different spans to compute the initial acceptance rate.

Methodologically, we show how to realistically implement a two-lab design with no deception to observe a large number of choices with real consequences without using the strategy method. This design allows us to identify individual response strategies and how they evolve in time, pin down behavioral types and use them to account for systematic individual differences in decision time.

Our result has limitations. First, in principle, one could argue that our participants were all time constrained since respondents had to decide within 2 s. With "Error" rates of less than 1 percent, the time constraint seems nonetheless to have rarely been binding. So our experiment differs from the studies with partly stressful (binding) time constraints in that response times resulted endogenously with hardly any fear of censoring.

Second, the result can be limited to our game and parameters and by the severely limited sample size. While all of this is true, we hope to have provided a solid enough proof of the dangers of relying on average results, and on the importance of self-priming when decision time is used to assess the intuitiveness of behavior in games.

In light of our results, the methods used in the debate on whether the intuitive, or *default* tendency of human agents is cooperation or selfishness need to be reconsidered. Simply using response times as proxies for decision modes can be misleading, and other approaches are needed, for instance exogenous manipulations inducing different decision modes complemented by eye-tracking, as done by Barrafrem and Hausfeld (2020). Any contradictory result in this literature might be due to wide and often unaccounted heterogeneity in the population under study or in self-prime during the usually unconstrained instructions phase. While this effect *might* be controlled for by randomization into between-subjects treatments, the usually small number of subjects per condition coupled with the fact that we do not really know how far individual heterogeneity can go advise for caution in using response times manipulations to identify decision modes.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.joep.2021.102419.

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