Is fairness intuitive? An experiment accounting for the role of subjective utility differences under time pressure

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Is fairness intuitive? - An experiment accounting for subjective utility differences under time pressure*

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Abstract

Evidence from response time studies and time pressure experiments has led several authors to conclude that "fairness is intuitive". In light of conflicting findings we provide theoretical arguments showing under which conditions an increase in "fairness" due to time pressure indeed provides unambiguous evidence in favor of the "fairness is intuitive" hypothesis. Drawing on recent applications of the Drift Diffusion Model (Krajbich et al., 2015a), we demonstrate how the subjective difficulty of making a choice affects decisions under time pressure and time delay, thereby making an unambiguous interpretation of time pressure effects contingent on the choice situation. To explore our theoretical considerations and to retest the "fairness is intuitive" hypothesis, we analyze choices in two-person binary dictator and prisoner's dilemma games under time pressure or time delay. In addition, we manipulate the subjective difficulty of choosing the fair relative to the selfish option. Our main finding is that time pressure does not consistently promote fairness in situations where this would be predicted after accounting for choice difficulty. Hence, our results cast doubt on the hypothesis that "fairness is intuitive".

keywords: distributional preferences, cooperation, time pressure, response times, cognitive processes, drift diffusion models

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1 Introduction

Economists are increasingly interested in understanding the cognitive (Alós-Ferrer and Strack, 2014) and emotional (Loewenstein, 2000; Hopfensitz and Reuben, 2009; Drouvelis and Grosskopf, 2016) processes that drive pro-social behavior. One of the central questions within this literature is whether "fairness" is intuitive and automatic or follows from a deliberative weighting of the costs and benefits of making a fair choice. Several authors have approached this question by analyzing response times as a proxy for deliberation (Rubinstein, 2007; Spiliopoulos and Ortmann, 2017). A popular method for understanding the causal impact of deliberation on choices is to place subjects under time pressure or time delay, given that subjects who are constrained to make a fast choice might increase their reliance on intuition compared to subjects who are constrained to wait before making a choice (Wright, 1974; Rand et al., 2012).

Using this method Rand et al. (2012, 2014) find that average contributions in a public good game are higher when subjects are placed under time pressure as compared to subjects who are forced to delay their contribution decision. These results have inspired the "fairness is intuitive" (FII) (Cappelen et al., 2016) hypothesis. According to the FII hypothesis, a decision maker intuitively prefers fairness, i.e. cooperation in a public good or sharing resources in a dictator game.[1] However, this predisposition towards fairness can be overridden by a more deliberative weighting of the costs and benefits, such that deliberation can promote selfishness (Rand et al., 2012).

The FII hypothesis has not been unequivocally confirmed empirically. In contrast to the original results of Rand et al. (2012), Tinghög et al. (2013), Verkoeijen and Bouwmeester (2014), and Bouwmeester et al. (2017) do not find that constraining deliberation by time pressure increases the fraction of cooperative choices in one-shot public good games. Furthermore, Tinghög et al. (2016) find that time pressure does not affect the fraction of fair choices in (modified) dictator games. Finally, findings in Capraro and Cococcioni (2016) and Lohse (2016) suggest that placing subjects under stronger time pressure leads to more selfish choices in public good games. Similarly, Mrkva (2017) finds that time pressure leads to an increase of selfish choices in modified dictator games with high stakes, but not with low stakes.

In light of this mixed evidence, we conduct a new test of the FII hypothesis. In this test, we address a recent concern that factors other than intuition and deliberation also affect response times and thereby distort the identification of intuitive or deliberative choices from fast and slow responses (Recalde et al.,

[1] Obviously, the economics literature has come up with various notions of what constitutes a "fair" choice (Rabin, 1993; Engelmann and Strobel, 2004; Fehr and Schmidt, 2006). In section 2, we will describe in more detail what we refer to as a "fair" choice in the context of our paper.

2014; Krajbich et al., 2015a). We explore how the subjective difficulty of choosing between a fair and a selfish option, as one such factor, affects choices under time pressure and time delay. Our theoretical predictions highlight that, without controlling for the effect of choice difficulty in a given situation, observing a positive effect of time pressure is not necessarily evidence in favor of the FII hypothesis; and observing no effect of time pressure is not necessarily evidence against the FII hypothesis. Thereby, we provide one plausible explanation why previous tests of the FII hypothesis might have come to different conclusions.

Our theoretical considerations are based on insights from a recent paper by Krajbich et al. (2015a) who use a Drift Diffusion Model (DDM) to illustrate how choice difficulty may affect response times. The central prediction of the DDM is that more difficult choices, i.e. those in which the utility difference between the fair and the selfish option are small, are associated with longer response times. We build on this insight and explore how the subjective difficulty of making a choice affects a *causal* test of the FII hypothesis. Our analysis is based on the assumption that choices under time pressure may be affected by both, the amount of deliberation involved in the choice and the subjective difficulty of making a choice (Alós-Ferrer, 2016). Hence, the overall effect depends on how time pressure affects choices according to the FII hypothesis *as well as* the DDM.

We use a simple version of the DDM to show that time pressure causes decision makers who perceive smaller utility differences to make more mistakes. Thus, the DDM predicts that time pressure can either increase the fraction of fair choices, if fair decision makers perceive larger utility differences and are less common in the population; or decrease the fraction of fair choices, if selfish decision makers perceive larger utility differences and are less common in the population. The mechanism motivating the FII hypothesis on the other hand predicts that time pressure should always increase the fraction of fair choices in one-shot games. Hence, whenever fair decision makers perceive larger utility differences than selfish decision makers and are less common in the population, the DDM and the FII both predict that time pressure should increase the fraction of fair choices. Observing a positive effect of time pressure in these situations can therefore only provide ambiguous evidence in favor of the FII hypothesis as the same pattern could also be explained by the DDM, while observing no effect is unambiguous evidence against the claim that "fairness is intuitive". On the other hand, whenever selfish decision makers perceive larger utility differences than fair decision makers and are less common in the population, the FII hypothesis and the DDM predict opposite effects of time pressure, which may even cancel each other out. Observing no or even a negative effect of time pressure in these situations is not sufficient to unambiguously reject the claim that "fairness is intuitive", while observing a positive effect provides unambiguous evidence in favor of the FII hypothesis. These arguments illustrate that classifying a choice situation into one of these types is central for the correct interpretation of time pressure effects. Otherwise the FII hypothesis could be spuriously accepted or rejected. The fact that previous studies have not explicitly accounted for subjective utility differences might explain why they have arrived at different conclusions.

To causally test the FII hypothesis, we conduct an experiment in which subjects take decisions under time pressure or time delay in multiple two-person binary dictator and prisoner's dilemma games. Across games, we vary the subjective attractiveness of the fair option by increasing the social benefits of fair behavior. Specifically, our experiment includes choice situations in which we expect that decision makers who prefer the fair option will find it subjectively more, less or as difficult to choose as decision makers who prefer the selfish option such that the DDM and the FII make either consistent or opposite predictions concerning the effect of time pressure. To classify choice situations into one of these two possible types, we use an additional treatment, in which subjects are unconstrained in their response time and in which we observe response time correlations and choice frequencies. According to Krajbich et al. (2015a), we should find that fair choices are correlated with shorter response times in decision problems in which fair choices are subjectively less difficult than selfish choices and vice versa.

Our experiment comprises two further elements: first, it allows for a between- as well as a within-subject test of the FII hypothesis. Within-subject evidence is obtained by letting subjects take the same decision twice in each game, once under time pressure and thereafter under time delay. Second, by comparing evidence from binary dictator and prisoner's dilemma games, we are able to distinguish between fair choices in non-strategic and strategic decisions. Thereby, we investigate whether pro-social behavior follows a common cognitive pattern across different contexts. While several previous tests of the FII hypothesis are based on evidence from strategic decisions in public good or prisoner's dilemma games, non-strategic decisions in simple binary dictator games might allow for a more direct test given that they are unconfounded by strategic uncertainty or misconceptions regarding the game.

Overall, our analysis provides at most limited empirical support for the hypothesis that "fairness is intuitive". In those binary dictator and prisoner's dilemma games, in which our classification suggests that time pressure should increase fairness according to both models, we do not observe such increase across all between-subjects tests. In the same games, there is no consistent within-subjects evidence that subjects who choose the fair option under time pressure are more likely to switch to the selfish option under time delay. In binary dictator games in which an increase of fair behavior under time pressure would constitute unambiguous evidence in favor of the FII hypothesis we do not find that time pressure significantly increases the frequency of fair choices. This evidence holds between- and within-subjects. A complementary analysis shows that switching patterns strongly reflect choice difficulty (subjective indifference), a pattern that is supported by the DDM but not by the FFI hypothesis.

The remainder of the paper is organized as follows: section 2 contains a detailed description of the DDM and summarizes our predictions. In section 3, we explain our experimental design. The results are summarized in Section 4. In section 5, we conclude with a short discussion of our results.

2 Theory and Predictions

The FII hypothesis is based on a dual-process framework in which decisions are jointly determined by a fast and intuitive system I and a more deliberative and rather slow system II (Kahneman, 2003; Frederick, 2005). According to the "Social Heuristics Hypothesis" (Rand et al., 2014), the intuitive system I follows a cooperation heuristic that individuals have developed in repeated everyday interactions. Upon deliberation, the same individuals may realize that there are no strategic incentives to cooperate in atypical one-shot situations implemented in the lab which leads to more defection. Cooperation is the most prominent application of the "Social Heuristics Hypothesis". Its underlying mechanism could, however, apply more broadly to non-strategic choices in the dictator game assuming that sharing resources with other people is also an advantageous long-term strategy because of reciprocity or reputation concerns. We summarize the claim that intuition promotes fairness across different contexts as the FII hypothesis.

The FII hypothesis generates empirically testable predictions concerning the effect of time pressure and time delay on fairness. Since heuristics are seen to operate relatively independently from the details of a choice situation, the FII hypothesis predicts that the same decision maker is more likely to choose the fair option when placed under time pressure than when she makes a deliberative choice. Similarly, when observing choices of different decision makers, subjects who are placed under time pressure should on average choose the fair option more frequently than subjects constrained to wait before making a choice.

However, the observation that time pressure leads the same decision maker to choose the fair option with higher probability or that time pressure increases the fraction of fair choices cannot be unambiguously interpreted as evidence in favor of the FII hypothesis without accounting for choice difficulty. To illustrate how the subjective difficulty of the choice situation could affect choices under time pressure and thereby confound a test of the FII hypothesis, we describe the DDM in more detail.[2]

[2]We will refer to versions of the DDM that have recently been applied to value-based choices

2.1 Time Pressure in the Drift Diffusion Model (DDM)

Assume that a single decision maker faces a binary choice between a "fair" (F) and a "selfish" (S) option. According to the DDM, this decision maker is initially unaware of the utility value she receives from these options. However, she can accumulate stochastic information regarding her preferences in a series of time periods t. In each t, the decision maker observes two new stochastic value signals F_t and S_t which are normally distributed around her true underlying utility values. The difference between the two signals $F_t - S_t$, is added to a subjective state variable X_t^i which, thus, encodes the probability that F yields a higher utility than S (Krajbich et al., 2014; Caplin and Martin, 2015). The accumulation process continues until the subjective state variable crosses a pre-defined upper threshold a, inducing the decision maker to choose F, or the lower threshold b, inducing the decision maker to choose S. The length of the accumulation process, i.e. the number of time periods before the upper or lower threshold is reached, corresponds to the decision maker's response time.

The standard DDM makes two predictions regarding the theoretical distribution of response times and decision errors (e.g., Ratcliff and Rouder, 1998).[3] First, the decision maker's response time depends on the underlying absolute utility difference, $|u^i(F) - u^i(S)|$. If this difference is large, the decision maker is expected to decide faster than if the underlying absolute utility difference is small because she has to sample fewer signals to reach one of the thresholds. Second, given that the final decision is reached by observing a series of noisy signals, the decision maker is more likely to make a mistake (i.e. to choose the option that she does not prefer given her own preferences), the smaller the underlying utility difference between the two options. A small utility difference between the fair and the selfish option implies that the decision maker is more likely to receive signals that contradict her "true" preference. This, in turn, increases the likelihood of making a mistake by choosing the non-preferred option.

Jointly, these two properties of the DDM generate a third prediction concerning the effect of time pressure and time delay on choices. Time pressure forces decision makers with otherwise longer response times to make a choice before being sufficiently sure about their truly preferred option. Thus, time pressure is equivalent to a reduction in the decision thresholds. This induces decision makers to choose at lower precision because noise has a higher likelihood of influencing their decision.

and social dilemma situations (Polanía et al., 2014; Krajbich et al., 2014, 2015b). For a more extensive review of the behavioral foundations and the application of DDM in psychology refer to the descriptions in Ratcliff (1988), Ratcliff and Rouder (1998) and a recent summary of this topic aimed at economists by Clithero (2016).

[3] A more detailed description of the DDM as well as proofs and derivations of all predictions are contained in Appendix A.

Importantly, the likelihood of making a mistake is larger for decision makers with smaller absolute utility differences because their value signals contain relatively less information relative to noise.

Aggregating these individual level effects provides predictions for how overall choice frequencies are affected by time pressure. For illustrative purposes, we will distinguish between three situations, labeled *type 0*, *type 1* or *type 2*. Furthermore, we will refer to a decision maker as "selfish" or "fair" depending on which of the two options yields a higher utility value according to her subjective preferences. In situations of *type 0*, the incentives are such that the underlying absolute utility differences are the same for the average selfish and fair decision maker. Thus, fair and selfish decision makers are equally likely to make a mistake under time pressure and time delay. In situations of *type 1*, on the other hand, the absolute utility difference is larger for the average fair than for the average selfish decision maker. Hence, in these situations selfish decision makers are more likely to make a mistake. Finally, in situations of *type 2*, the utility differences are larger for the average selfish than for the average fair decision maker such that fair decision makers are more likely to make a mistake.

Under the simplifying assumption that time pressure exclusively affects decision makers with smaller average utility differences (i.e. weak preferences for one of the options) and that there are no mistakes under time delay, the DDM generates straightforward predictions. In situations of *type 1*, time pressure exclusively causes selfish decision makers to make a mistake such that time pressure inflates the frequency of fair choices relative to a situation without time pressure. For situations of *type 2*, the DDM predicts the reverse effect. Here, fair decision makers should make more mistakes under time pressure, thus reducing the fraction of fair choices under time pressure.

Without this simplifying assumption (i.e. assuming that the probability of making a mistake is positive under time pressure and, to a smaller degree, under time delay for all decision makers), the DDM predictions depend on two factors: first, the average strength of preferences and second, the relative frequency of fair and selfish decision makers within the population.[4] The strength of preferences determines the likelihood of committing an error under time pressure and time delay for a given type of decision maker. The population shares, on the other hand, determine the resulting absolute number of mistakes and the aggregate direction of switches. The most simple test case for the FII hypothesis is a situation of *type 0* in which the relative population shares of fair and selfish decision makers are roughly similar. In such a perfectly balanced situation - however rare such situations might be in actual empirical tests - the DDM predicts that time pressure should have

[4]We are grateful to an anonymous referee for pointing out this crucial distinction and helping us to refine our model.

Table 1: Testing the FII hypothesis

		Predicted effects of Time Pressure		
		Type 0 $p(f) = 0.5$	Type 1 $p(f) < 0.5$	Type 2 $p(f) > 0.5$
Observed effect	↑	unambiguous accept (0a)	ambiguous accept (1a)	unambiguous accept (2a)
	↔ ↓	unambiguous reject (0b)	unambiguous reject (1b)	ambiguous accept (2b)

no effect on the frequency of fair choices since fair and selfish decision makers are equally likely to make a mistake (under time pressure and time delay) and both groups are of equal size. Consequently, the absolute number of mistakes is perfectly balanced between both groups and there should be no effect of time pressure. The DDM also generates unambiguous predictions when the type of decision maker who has larger utility differences is less common within the population (< 50%). In these cases, the DDM predicts that time pressure increases the fraction of choices which are associated with larger absolute utility differences. For example, if the fair option is preferred by less than 50% of subjects in a situation of *type 1* (where fairness is "easy"), time pressure should increase the fraction of fair choices. This increase is driven by two factors: first, selfish decision makers are more likely to make an error under time pressure and to switch to their preferred choice under time delay as compared to fair decision makers. Second, given that they constitute the larger group, there should be more switches from the fair (under time pressure) to the selfish option (under time delay) than vice versa.

In all other cases, i.e. when the decision makers who have larger utility differences are more common in the population, the predictions of the DDM depend on the relative population shares as well as the unobservable difference in error rates under time pressure and time delay for both types of decision makers.[5]

2.2 Testing the FII hypothesis accounting for DDM predictions

Assuming that choices under time pressure and time delay are affected by the relative use of intuition over deliberation *as well as* the subjective difficulty of making a choice, the arguments above imply that the predictions of the DDM and

[5] Appendix A contains a more formal discussion of the possible results.

the FII are congruent in situations of *type 1* as long as the fraction of fair decision makers is smaller than 50%. Hence, observing that time pressure increases the fraction of fair choices in these situations can only provide ambiguous evidence in favor of the FII hypothesis because the same observation could be fully accounted for by the DDM (see Table 1, 1a). Instead, if we do not find these predicted patterns, then this constitutes unambiguous evidence against the FII hypothesis (1b).[6]

In contrast, unambiguous evidence in favor of the FII hypothesis can be obtained from situations of *type 2*, as long as the fraction of selfish decision makers is smaller than 50%. Here, the FII hypothesis and the DDM predict opposite time pressure effects which may even cancel each other out. Thus, observing that time pressure does increase the fraction of fair choices would be unambiguous evidence in favor of the FII hypothesis (2a). Not observing any or even a negative effect would not necessarily be inconsistent with the FII hypothesis because the opposite effects of the FII hypothesis and the DDM may actually cancel each other out (2b).

Finally, in situations of *type 0* in which relative population shares are roughly similar, the DDM should have little influence on the direction of time pressure effects as fair and selfish decision makers are equally likely to make mistakes and are present in equal proportions within the population. Thus, observing an increase of fair behavior in such situations would be unambiguous evidence in favor of the FII, while observing no or a negative effect would provide unambiguous evidence against the FII.

Whenever the DDM predictions regarding the direction of time pressure effects are not clear because they depend on unobservable differences in error rates, tests of the FII hypothesis cannot be interpreted unambiguously. Therefore, classifying the choice situation as *type 0*, *type 1* or *type 2* and approximating the population shares of fair decision makers is necessary for correctly interpreting the evidence. Previous tests of the FII hypothesis might, thus, suffer from spuriously accepting the FII hypothesis based on observing an increase of fairness in situations of *type 1* or spuriously rejecting it based on observing no effect or a decrease of fairness in situations of *type 2*.

[6]Note that observing no effect is not necessarily evidence against the DDM in these situations. This is because the true model might be that "selfishness is intuitive". Hence, a negative effect of time pressure attributable to the "selfishness is intuitive" model might be cancelled out by a positive effect attributable to the DDM. For this reason, we cannot *jointly* reject the FII hypothesis *and* the DDM.

3 Experimental Design

In our experiment, we collect decisions from four binary dictator (see Table 2) and four prisoner's dilemma games (see Table 3). In each game, subjects are asked to choose between a "fair" and a "selfish" option (labeled option "A" or "B" on the decision screen). In line with the FII hypothesis (Rand et al., 2014), we label a choice as "fair" if it implies sharing resources with another individual at own costs. According to this definition the equal allocation is the "fair" choice in the binary dictator (BD) games and cooperation is the "fair" choice in the prisoner's dilemma (PD) games. Across the four BD and PD games, we increased the social benefits of choosing the fair option from VERY LOW to HIGH. For example, in the VERY LOW binary dictator game, choosing the fair (equal) option increases the recipient's payoff by 10 cents for every Euro that the dictator gives up relative to the selfish (unequal) option. In HIGH, the recipient receives 2.25 for every Euro that the dictator gives up.[7]

If subjective utility differences reflect the costs and benefits of choosing the fair option (Andreoni and Miller, 2002), we expect that fair decision makers should perceive smaller utility differences in the VERY LOW games than selfish decision makers. In these games, the benefits of choosing the fair option are relatively small since the decision maker needs to sacrifice a high amount of her own payoff to increase the payoff of the other participant by only a small amount. Hence, these games potentially resemble a type 2 choice situation that would allow for an unambiguous test of the FII hypothesis. By the same logic we expect that the HIGH games resemble a type 1 choice situation in which fair decision makers perceive larger utility differences than selfish decision makers. Here, decision makers need to give up only a small amount in order to increase the payoff of the other participant by a high amount.

Despite these considerations, it is hard to predict a priori if choosing the fair option will be subjectively more or less difficult than choosing the selfish option in a given game. Furthermore, a correct interpretation of the evidence also requires a measure of whether the fair or the selfish option is preferred by a majority of decision makers. To gain empirical insights into the subjective difficulty of choosing the fair and the selfish option as well as the respective population shares, we conducted additional sessions in which subjects could decide without being constrained in their response times. Based on the previous finding that response times reflect the relative difficulty of the choice situation (Krajbich et al., 2015a), we use these additional observations to classify games as type 0, 1 or 2.

We used the following procedures in our experiment: Part 1 of the experiment

[7]Labeling the equal outcome as fair in the binary dictator game also aligns our FII predictions with recent findings in Capraro et al. (2017) who show that equal outcomes are preferred by intuitive decision makers whereas deliberation allows for a variety of motives to affect decisions.

Table 2: Binary dictator games used in the experiment

VERY LOW		LOW		MEDIUM		HIGH	
Unequal	11, 0	Unequal	9, 0	Unequal	10, 1	Unequal	15, 2
Equal	1, 1	Equal	3, 3	Equal	6, 6	Equal	11, 11

Table 3: Prisoner's dilemma games used in the experiment

VERY LOW			LOW			MEDIUM			HIGH		
	C	D		C	D		C	D		C	D
C	3.10, 3.10	1, 5.10	C	4, 4	1, 6	C	6, 6	1, 8	C	8, 8	1, 10
D	5.10, 1	2, 2	D	6, 1	2, 2	D	8, 1	2, 2	D	10, 1	2, 2

consisted of two successive blocks. In block 1, subjects made decisions in the four prisoner's dilemma games displayed in Table 3 in randomized order. After each prisoner's dilemma game, subjects made choices in unrelated filler games (see Appendix B). Once subjects had completed block 1 and a short questionnaire, we elicit choices in the exact same four prisoner's dilemma and filler games again in block 2. The games were presented in the same order in block 1 and 2 for each subject.[8]

Part 2 of the experiment also consisted of two successive blocks. In block 1, subjects made choices in the four binary dictator games displayed in Table 2 in randomized order. Choices were elicited using the strategy vector method, i.e. both subjects in a pair made a choice before the computer randomly assigned them to the roles of dictator or recipient. After each binary dictator game, subjects took choices in three filler games (see Appendix B). Once subjects had completed block 1 and another short questionnaire, they made choices in the same four binary dictator and filler games again in block 2.

For each binary choice, subjects were randomly re-matched in pairs and no feedback on their partner's choice was given until the very end of the experiment. At the end of the experiment, one of the games was randomly drawn and subjects were paid according to their own and their partner's choice.

To analyze the effect of time pressure on the fraction of fair choices, we randomly assigned subjects to one of four (between-subjects) conditions, in which we implemented different response time constraints: in the two Time Pressure conditions, TP and STP, subjects were constrained to choose under time pressure in block 1 and forced to wait before making a choice in block 2. In the Time Delay

[8]We randomized the order in which the prisoner's dilemma games were displayed across sessions. The filler games were presented in the same order in all sessions. Subjects were not informed that they would make the same choices in both blocks.

Table 4: Experimental Design

		TIME PRESSURE (TP)	STRONG TIME PRESSURE (STP)	TIME DELAY (TD)	UNCON-STRAINED (U)
PART 1	BLOCK 1 4 PDs + 4 Filler Games	≤ 12 seconds	≤ 8 seconds	> 12 seconds	no constraint
	BLOCK 2 4 PDs + 4 Filler Games	> 12 seconds	> 12 seconds	> 12 seconds	no constraint
PART 2	BLOCK 1 4 BDs +12 Filler Games	≤ 6 seconds	≤ 4 seconds	> 6 seconds	no constraint
	BLOCK 2 4 BDs + 12 Filler Games	> 6 seconds	> 6 seconds	> 6 seconds	no constraint

This table summarizes the Experimental Design. Each cell displays the response time limit which subjects faced during their choice. We abbreviate prisoner's dilemma as "PD", and binary dictator game as "BD".

(TD) condition, subjects were forced to delay their decision in both, block 1 and block 2. In the Unconstrained condition subjects did not face an exogenous time limit in either block.

In the Time Pressure (TP) condition, the time limit was 12 seconds for all prisoner's dilemma games and 6 seconds for all binary dictator games. These time limits correspond to the first quartile of the response time distribution of the *first* choice in the Unconstrained condition.[9] Given that subjects usually get faster over time and that it is unclear how much time is required to induce intuitive decisions[10], we implemented a stricter time limit of 8 seconds in the PD games

[9] To our knowledge there is no common method according to which time pressure was defined in previous studies. For instance, subjects in Rand et al. (2012) were constrained to decide within 10 seconds which corresponds to the median response time in their response time correlation study. Buckert et al. (2017) define time pressure as 2/3 of the median response time in a Cournot game. Our analysis of response times in the Unconstrained treatment revealed that the response time distribution of the 25% fastest decision makers was independent of the order in which the games were presented. Thus, the time limit in our study avoids heterogeneous effects across different order conditions.

[10] For instance, Myrseth and Wollbrant (2017) argue that any time limit above 4 seconds could

which was reduced to 4 seconds in the BD games in the Strong Time Pressure (STP) condition. These time limits correspond to the first quartile of the response time distribution for the *last* decision in the Unconstrained condition. The time delay limit was 12 seconds for the PD games and 8 seconds for the BD games in both the TP and the STP condition, so that there is a small gap in the STP condition. The payoffs were displayed graphically as stacked and colored bars in all games (see Appendix B) in order to make them easily accessible and comparable, even under time pressure.

To ensure compliance with our treatment, we forced subjects to delay their decision by displaying the choice buttons only after 12 seconds (6 seconds) had passed. Since compliance with time pressure cannot be enforced in the same way, we instead chose to incentivize compliance by informing subjects that they would lose their show-up fee of 3 Euro if they violated the time constraint in the decision chosen for payment.[11] A counter, displaying seconds spent, was included on each decision screen in both the Time Delay and the Time Pressure conditions.

At the end of part 1, we elicited subjects' beliefs regarding the choices of other participants which allows us to test whether time pressure and time delay affected beliefs differently.[12] Subjects were paid an additional Euro for a correct guess. In addition, we asked subjects to provide a subjective assessment regarding which of the two options they perceive as the fairer option for the very first BD and PD games they encountered in each block. This assessment can be used to identify if the equal (cooperative) option is indeed perceived as "fair" by a majority of our subjects.[13]

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allow decision makers to engage in some level of deliberation. Spiliopoulos and Ortmann (2017) report that mean response times fall by up to 30 percent when subjects face the exact same game multiple times.

[11] One important limitation of previous studies has been that a large fraction of subjects violate the time constraints set by the experimenter which potentially reduces their explanatory power (Tinghög et al., 2013; Bouwmeester et al., 2017). In contrast, we observed few violations of the time limit: Averaged over all decisions and treatments, the time pressure conditions were violated in 2.5 percent of the BD and 1.7 percent of the PD games. There is no significant difference in violations between the TP and STP condition.

[12] In the Time Pressure treatment, subjects were constrained to indicate their belief within 12 seconds. In the Time Delay treatment, subjects could indicate their belief only after 12 seconds had passed.

[13] Despite being unincentivized and thus noisy, this survey approach can provide some insights into the modal fairness perceptions of subjects (Faravelli, 2007; Cubitt et al., 2011; Reuben and Riedl, 2013).

4 Results

The experiment was conducted at the University of Heidelberg AWI Lab. In total, 238 undergraduate and graduate students of all disciplines were recruited to participate in the experiment (62 in Unconstrained, 74 in Time Delay, 72 in Time Pressure and 30 in Strong Time Pressure) via HROOT (Bock et al., 2014). We restricted our recruitment to subjects who had not participated in more than four experiments (and no experiment involving social dilemma or distribution tasks). The experiment was programmed in z-Tree (Fischbacher, 2007). Subjects received all instructions (reproduced in Appendix B) on the screen and questions were answered privately. At the end of the experiment, subjects were paid in private. The average earnings were 12 Euro, including a 3 Euro show-up fee. In the following, we will report the results of the Unconstrained condition before analyzing the results of the Time Pressure and Time Delay conditions.

4.1 Unconstrained condition

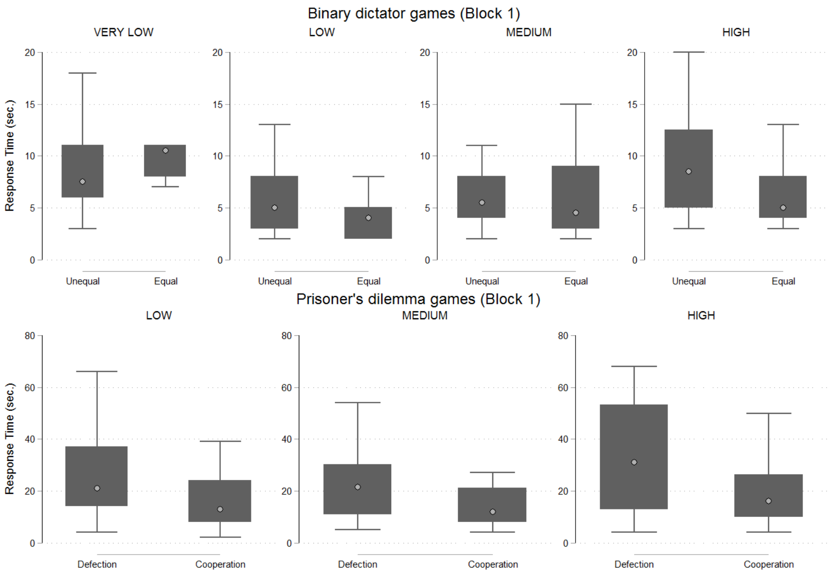
The purpose of the Unconstrained condition was to identify situations in which the fair choice is faster or slower than the selfish choice and to approximate the frequency of fair and selfish choices. This information can be used to classify the different games according to the theoretical considerations outlined in section 2.

In Figure 1 (top panel) we compare the distribution of response times between choices of the equal ("fair") and the unequal ("selfish") option in the BD games. The frequency of "fair" choices rises significantly from 9.7% in the VERY LOW game to 43.5% in the LOW, 51.6% in the MEDIUM, and to 61.3% in the HIGH game (Pairwise Sign Test, $p < 0.01$).[14] In line with the results in Krajbich et al. (2015a), we observe that the correlation between choices of the equal option and response times reverses as the benefits of the fair option increase: in the VERY LOW game, the median response time of subjects who chose the equal option is larger than the median response time of subjects who chose the selfish option (Rank-sum test, $p < 0.1$). Hence we classify this game as type 2. In the LOW and HIGH games, the median response times of subjects who chose the equal option are smaller than the response times of subjects who chose the selfish option (Rank-sum test, $p < 0.1$) which is why we classify these games as type 1. There is no significant difference in response times for the MEDIUM game (Rank-sum test, $p = 0.64$) which thus constitutes a type 0 game.

We use observed choice frequencies to determine if the DDM makes unambiguous predictions concerning the effect of time pressure in the different games.

[14] In the Unconstrained condition the games were separated by additional distribution tasks, which were replaced by different filler games in the subsequent Time Pressure and Time Delay conditions. A full analysis of all 12 BD games is available upon request.

Figure 1: Response times in prisoner's dilemma and binary dictator games (Unconstrained condition)



For the only type 2 situation (VERY LOW), the share of selfish decision is much larger than 50% such that the DDM makes ambiguous predictions regarding the expected effect of time pressure. For the two type 1 situations, the DDM makes unambiguous predictions for the LOW game ($< 50\%$ fair choices) but not for the HIGH game in which a majority of subjects chose the fair option. For the MEDIUM game, the DDM unambiguously predicts that time pressure should not have any effect on the fraction of fair choices given that subjects choose the fair and the selfish option at roughly equal rates (Binomial test, $p = 0.9$). Thus, solely the LOW and the MEDIUM game allow for unbiased tests of the FII hypothesis.

The distribution of response times for the three prisoner's dilemma games are displayed in the bottom panel of Figure 1.[15] Most importantly, the fraction of cooperators increases with the benefits: only 34% of subjects chose to cooperate in LOW, while this frequency rises to 55% in the MEDIUM and to 58% in the HIGH game. Looking at response times, we find that the median response time of subjects who chose to cooperate is significantly smaller than the median response time of those subjects who chose to defect in each of the three games (Rank-sum test, $p < 0.05$). Thus, the Unconstrained condition only includes PDs of type

[15]We later added the VERY LOW game in the subsequent Time Pressure and Time Delay sessions because each of these games represent a type 1 situation.

1. Looking at the fraction of fair choices, the DDM only makes an unambiguous prediction in the LOW game since the share of cooperators is smaller than 50% in this game. For the MEDIUM and HIGH games, on the other hand, the DDM predictions are not unambiguous and hence they cannot provide unambiguous evidence in favor of or against the FII hypothesis. To also analyze the effect of time pressure in a game that is more likely to be of type 2, we added an additional prisoner's dilemma game (VERY LOW) in the Time Pressure and Time Delay conditions in which we further reduced the benefits of cooperation.[16]

4.2 Constrained response time in the binary dictator games

We begin our discussion of the constrained decision time treatments with a series of manipulation checks. Most importantly, time pressure significantly speeds-up decisions across all BD games from an average of 13.34 seconds (CI: 11.58, 15.11) in the TD to 3.22 seconds (CI: 3.02, 3.44) in the TP and 2.16 seconds (CI: 1.97, 2.36) in the STP condition.[17] In addition, average decision times are significantly smaller in the STP as compared to the TP condition (Rank-sum test, $p \leq 0.001$). Game-wise comparisons furthermore indicate that the effect of time pressure is similar across different games and significantly reduces response times in all four decisions (Rank-sum test, $p \leq 0.001$).[18] Finally, subjects in the TP and STP conditions, who take their first decision under time pressure and their second decision under time delay, are significantly faster (Sign-rank test, $p \leq 0.001$) when taking their first decision as compared to their second decision (TP: 9.66 seconds [CI: 9.04, 10.30]; STP: 9.51 seconds [CI: 7.90, 11.13]). Overall, these comparisons indicate that time pressure successfully induced faster decision making among subjects.

In a second manipulation check, we analyze whether subjects indeed perceive the equal option as the fair outcome in all four binary dictator games. For this purpose we analyze subjective (unincentivized) fairness statements elicited at the end of the experiment. We find that in all games, a large majority of subjects perceive the equal option as the fairest outcome (81% in VERY LOW, 97% in LOW, 100% in MEDIUM, 100% in HIGH). We also find that subjective fairness

[16]Since we do not observe response time correlations or choice frequencies for this game, all time pressure results can only be interpreted under the assumption that it indeed represents a type 2 situation in which there is a majority of fair decision makers. The second assumption is unlikely to hold, given that in the LOW game already only 34% of subjects cooperate despite stronger incentives to cooperate.

[17]Note, that the mean decision time in the TD condition is significantly higher than 6 seconds and only a minority of decisions (13.8 percent) is made within the range of 6-7 seconds. This indicates that there are only few subjects in the TD condition, who have already completed their decision process when reaching the delay cutoff.

[18]More detailed statistics on response time distributions for each game are available in Appendix C.

Table 5: Between-subject comparison of the average rate of fair choices in the binary dictator games

	Time Delay		Time Pressure		p-Value Fisher's	Strong Time Pressure		p-Value Fisher's
	N	mean	N	mean	exact	N	mean	exact
VERY LOW	74	0.11	72	0.11	1	30	0.13	0.74
LOW	74	0.32	72	0.44	0.17	30	0.57	0.03
MEDIUM	74	0.53	72	0.60	0.41	30	0.63	0.39
HIGH	74	0.64	72	0.74	0.22	30	0.63	1

The mean rate of fair choices displayed is calculated over all orders. We report the p-Values of a two-sided Fisher's exact test, comparing the fraction of fair choices in the TD condition with the TP (column 6) and the STP condition (column 9).

assessments do not differ across the three conditions. This indicates that labeling the equal option as "fair" is strongly in line with the fairness perceptions of our subjects, in particular for the LOW and MEDIUM games that are of most interest for testing the FII hypothesis.

We now turn to analyzing the effect of time pressure on the fraction of fair choices in the BD games. Averaged over all decisions, we do not find evidence that subjects in the time pressure conditions chose the equal "fair" option significantly more often than subjects who took their decision under time delay (40% in TD vs. 47% in TP vs. 49% in STP, Rank-sum test, $p > 0.1$). The main results of our between-subjects test of the FII hypothesis are summarized in Table 5 in which we report the mean fraction of equal "fair" choices in each of the four games separately.

In the LOW game, the equal "fair" option is not chosen significantly more often when comparing the TD and TP conditions (Two-sided Fisher's exact test, $p = 0.17$). We obtain a different result, if we restrict our sample to those subjects who took their very first choice in this game (Two-sided Fisher's exact test, $p = 0.05$). When time pressure is stronger, we do find that the equal allocation is chosen significantly more often in the STP compared to the TD condition (Two-sided Fisher's exact test, $p = 0.028$), yet this significance vanishes when we restrict our analysis to first choices only (Two-sided Fisher's exact test, $p = 0.24$). Based on these results we can neither accept nor reject the hypothesis that "fairness is intuitive". In both treatments we observe that time pressure increases the fraction of fair choices either in the full sample or when restricting our analysis to first choices. Given that in the LOW game both the FII hypothesis and the DDM predict that time pressure should increase the fraction of fair choices, the observed increases in fair choices can, however, at most provide ambiguous evidence in favor of the FII hypothesis.

According to the DDM, time pressure should have no effect on the fraction of fair choices in the MEDIUM game. Hence an increase in fairness would be unambiguous evidence in favor of the FII. The fraction of subjects who select the equal option in the TP and STP conditions is indeed slightly higher under time pressure as compared to the TD condition but this increase is not significant (Two-sided Fisher's exact test; TP: $p = 0.41$, STP: $p = 0.39$). Restricting our comparison to first choices only does not alter this result (Two-sided Fisher's exact test; TP: $p = 0.76$, STP: $p = 0.10$). These results constitute unambiguous evidence against the FII hypothesis.

In the VERY LOW and HIGH game we find no evidence that time pressure affects the frequency of fair choices (Two-sided Fisher's exact test, $p > 0.1$). Since for these games it is unclear if the DDM predicts effects that are in line or orthogonal to the FII, we cannot unambiguously reject the FII based on these observations.

Result 1 (Between-Subject evidence in BDs) *We find evidence that time pressure increases the fraction of fair choices in games, in which this increase can be accounted for by both the DDM and the FII hypothesis (LOW game). In contrast, we do not find that time pressure significantly increases the fraction of fair choices in games, in which such increase can only be accounted for by the FII hypothesis (MEDIUM game).*

Our design also allows assessing within-subjects evidence by comparing a subject's initial choice under time pressure and her second choice (in the same game) under time delay. The two games that can provide unambiguous evidence in favor of or against the FII hypothesis are the LOW and the MEDIUM game. Given that the likelihood to switch from one to the other option may also be due to the fact that subjects gain more experience with the task between their first and their second decision, we compare the switching rates in the Time Pressure conditions to the switching rates in the Time Delay condition, where subjects take both decisions under time delay. To analyze switching behavior, we computed a variable that takes a value of 1 if a subject switched from the fair (first choice) to the selfish option (second choice), and a value of -1 if a subject switched from the selfish to the fair option (see Table 6).

First, looking at the switching rates in the two time pressure conditions, we do find that subjects are more likely to switch from choosing the fair option under time pressure to choosing the selfish option under time delay than vice versa in the LOW but not in the MEDIUM game. The former finding is consistent with the DDM and the FII hypothesis while the latter finding is inconsistent with the FII hypothesis. To control for a potential time trend in the probability to behave

Table 6: Within-subject comparison of switching behavior in the binary dictator games

	Time Delay			Time Pressure			Rank-sum p-Value	Strong Time Pressure			Rank-sum p-Value
	N	mean	Sign-rank	N	mean	Sign-rank		N	mean	Sign-rank	
	(within-subjects)			*(within-subjects)*			*(across)*	*(within-subjects)*			*(across)*
VLOW	74	0.04	0.18	72	0.03	0.41	0.78	30	0.1	0.08	0.32
LOW	74	0.07	0.19	72	0.15	0.02	0.27	30	0.27	0.01	0.05
MEDIUM	74	0.03	0.59	72	-0.03	0.64	0.48	30	0	1	0.80
HIGH	74	-0.01	0.74	72	0.11	0.03	0.05	30	-0.03	0.71	0.81

In this table, we report the direction of switches for each of the four binary dictator games. The switching variable takes a value of 1 if the subject switched from choosing the equal option in block 1 to choosing the unequal option in block 2. The decision in block 1 is taken under time pressure in the TP and STP condition and under time delay in the TD condition. The decision in block 2 is taken under time delay in all three conditions. Columns 4,7 and 11 report the p-Value of a Wilcoxon Sign Rank Test, performed on subject's switching behavior within one condition. In addition, we report the p-Value of a Rank-sum test, which compares switching behavior across the TD and TP (column 8) or STP (column 12) conditions.

fairly which is not caused by our treatment, we compare the switching rate in the LOW and MEDIUM games in the two time pressure conditions to the Time Delay condition. The results of the Rank-sum test are reported in Table 6. Our analysis shows that in the LOW game, subjects in the STP condition were indeed more likely to switch from the equal to the unequal option compared to subjects in the TD condition. However, given that the DDM and the FII hypothesis both support this prediction, the evidence can only provide ambiguous evidence in favor of the FII hypothesis. In contrast, there is no statistical significant difference in switching patterns for subjects in the TP and TD conditions. This result constitutes unambiguous evidence against the FII hypothesis. For the MEDIUM game we find no evidence that there is significantly more switching behavior under time pressure than under time delay. This is direct evidence against the FII hypothesis.[19]

The interpretation of the previous results rests on the assumption that we indeed classified the games correctly. As a robustness check, we employ a complementary within-subject test that does not depend on the classification of the games but instead exploits the fact that we observe choices in four different games per

[19] We do not find evidence that there are differences in switching behavior for the VERY LOW game, while there is significantly more switching for the HIGH game in the TP but not in the STP condition. Since both of these game can only provide ambiguous evidence in favor or against the FII hypothesis, we are not discussing these results in more detail.

subject. Based on these four choices we infer in which game a subject should be closest to her individual indifference point.[20] Let C_i=(x_1, x_2, x_3, x_4) describe the set of choices that a subject makes in the first four games such that $C_0 = (F, F, F, F)$ describes a subject who chooses the fair option in all four games and $C_2 = (S, S, F, F)$ describes a subject who chooses the selfish option only in the VERY LOW and LOW game. A C_0 subject is closest to her indifference point in the VERY LOW game since in this game choosing the fair option is more costly than in any of the other games. A C_2 subject is closest to her indifference point in the LOW or MEDIUM game since she switches from the selfish to the fair option between these two games. Overall, there are five different choice patterns that allow to approximate the location of the indifference point and 84.66% of subjects can be classified according to these patterns.[21] This classification can shed light on the role of subjective choice difficulty in the following way: the DDM predicts that subjects are more likely to make a mistake in games in which they are closer to indifference. Thus, when comparing a subject's first choices with her second choices in the same four games, she should be more likely to switch options in games closer to her indifference point. The FII, on the other hand, predicts that subjects should display a similar rate of switching for all games in which they have initially selected the fair option. Furthermore, there should be few to no switches in games in which subjects have initially selected the selfish option. These two predictions can be easily illustrated using an exemplary subject: assume a subject has chosen C_1=(S,F,F,F) in the initial four games and is classified accordingly. The FII hypothesis predicts that when comparing the subject's first to her second choices in the same games, she should switch to the selfish option with the same probability in the LOW, MEDIUM and HIGH games. Conversely, according to the DDM, the highest frequency of switches should occur in the VERY LOW or LOW game – as the exemplary subject is closest to her indifference point in these games – while there should be fewer switches in the MEDIUM and HIGH games. Figure 2 displays the propensity to switch in each game for each choice pattern.[22]

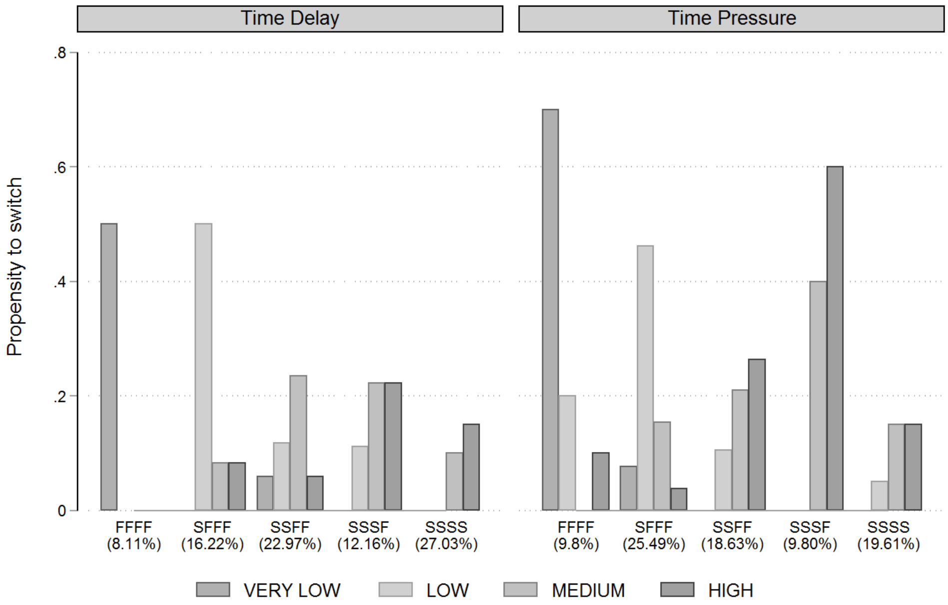
For almost all classifications, switching patterns are more closely in line with predictions of the DDM than with predictions of the FII hypothesis. With the

[20] This method rests on the assumption that subjects have transitive preferences over own-other allocations that are only violated by mistake (Andreoni and Miller, 2002).

[21] The five choice patterns are (F,F,F,F), (S,F,F,F), (S,S,F,F), (S,S,S,F) and (S,S,S,S). For any other pattern (e.g. (S,F,S,F)) there is no clear indication in which decision a subject might have made an error that violates transitivity and hence where the indifference point for this subject might be located. Note that a consistent pattern does not necessarily imply that subjects have not made any error since a (S,F,F,F) subject could have made an error in either the VERY LOW game implying that her actual preferences are (F,F,F,F) or in the LOW game implying that her actual preferences are (S,S,F,F) or could have made more than one error.

[22] Due to the smaller group size for some classifications in the STP condition, we pooled data from both time pressure conditions for this analysis.

Figure 2: Conditional switching probabilities in the BDs



This figure displays the propensity to switch between first and second choice in a given game across five different classifications of consistent decision making. The left panel displays switching behaviour when first choices have been made under time delay and the right panel displays switching behaviour when first choices have been made under time pressure. The percentages indicate how common a classification is within the population.

exception of the *SSFF* pattern, we observe that subjects are more likely to switch in games which are closer to their indifference point. In contrast, we find little evidence that subjects are switching at similar rates in all games in which they have chosen the fair option under time pressure. This is most evident for the *FFFF* pattern, where a majority of switches occur in the first (VERY LOW) game even under time pressure. In contrast to the predictions of the FII hypothesis, there is also substantive evidence for switching from the selfish to the fair option (most pronounced for the *SSSF* and *SSSS* choice patterns). Given that most of these switches occur for games that are close to individual indifference points, this pattern is closely in line with the predictions of the DDM.

Result 2 (Within-Subject evidence in the BDs) *We do find evidence that subjects are more likely to switch from the fair to the selfish option in games, in which this prediction is supported by the FII and the DDM (LOW); but not in* *games, in which this prediction is only supported by the FII hypothesis (MEDIUM). The latter provides unambiguous evidence against the FII hypothesis.*

A potential concern, given the observed decline in average fair behavior across decisions, is that subjects' choices as well as their response time may be influenced by the order in which the different games were presented. This concern should already be limited by the fact that we presented the games in a randomized order. In addition, we did not find any evidence in favor of the FII hypothesis using only the first decision taken by each subject. We additionally address this concern using a set of probit regression models. Each of these models takes individual choices in the four decisions of block 1 as a dependent variable. Importantly, the dependent variable encodes the order in which the choices were taken. That is, if a subject entered the LOW game on the first screen, it is coded as choice 1. We report the results of three different specifications in Table 10. In specification (1), we find no evidence that time pressure increases the frequency of equal choices, when controlling for order effects and the benefits of choosing the fair option. In specification (2) we add interaction terms between the treatment dummy and the benefits of choosing the fair option. Again, we find no evidence that time pressure significantly affects equal choices in any of the four games. Moreover, all interaction terms for the standard time pressure (TD) treatment are insignificant. This is further evidence that even in those games where both the DDM and the FII would predict an increase of fairness under time pressure there is no such effect. For stronger time pressure (STP), there is weakly significant evidence that time pressure increases the frequency of fair choices in the LOW game, but not in the MEDIUM game. The former finding is, however, predicted by both the DDM and the FII hypothesis. Finally, in specification (3) we add interaction terms between the TP and the SCREEN variables. These interactions terms would be significant if the order in which the games were presented would moderate the treatment effect - which we do not observe. As suspected, we do observe that the screen variables are significant in all three specifications. Thus, if a game was presented on a specific decision screen, the likelihood that a subject would choose the equal option was increased or decreased depending on the specification.

4.3 Constrained response time in the prisoner's dilemma games

As for the BD games, we find that time pressure significantly speeds up choices in the PD games.[23] Furthermore subjects' individual fairness assessments, which we elicited at the end of the experiment, are strongly consistent with our label: a large

[23] All response time statistics are available in Appendix C.

Table 7: Random effects probit regression for the effect of time pressure in the binary dictator games

	(1)	(2)	(3)
TIME PRESSURE (TP)	0.350	0.00634	0.249
	(1.33)	(0.01)	(0.43)
STRONG TIME PRESSURE (STP)	0.463	0.115	0.261
	(1.30)	(0.20)	(0.33)
LOW	1.986****	1.632****	1.707****
	(7.11)	(4.28)	(4.20)
MEDIUM	2.574****	2.480****	2.524****
	(9.18)	(6.26)	(6.22)
HIGH	2.773****	2.627****	2.698****
	(9.40)	(6.28)	(5.93)
SCREEN2	-0.345*	-0.382*	-0.259
	(-1.80)	(-1.95)	(-0.87)
SCREEN3	0.251	0.259	0.622**
	(1.41)	(1.44)	(2.02)
SCREEN4	0.176	0.197	0.239
	(0.71)	(0.77)	(0.63)
TP * LOW		0.541	0.392
		(1.12)	(0.69)
TP * MEDIUM		0.242	0.176
		(0.49)	(0.33)
TP * HIGH		0.489	0.436
		(0.88)	(0.77)
STP * LOW		1.010*	1.273
		(1.78)	(1.60)
STP * MEDIUM		0.291	0.567
		(0.49)	(0.83)
STP * HIGH		-0.0806	-0.0736
		(-0.13)	(-0.11)
TP * SCREEN2			-0.0606
			(-0.14)
TP * SCREEN3			-0.621
			(-1.51)
TP * SCREEN4			-0.0298
			(-0.05)
STP * SCREEN2			-0.602
			(-1.04)
STP * SCREEN3			-0.598
			(-1.26)
STP * SCREEN4			0.0114
			(0.02)
CONSTANT	-2.396****	-2.231****	-2.410****
	(-7.35)	(-5.85)	(-5.57)
Observations	704	704	704
Subjects	176	176	176
Prob > Chi^2	0.0000	0.0000	0.0000

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

majority of the subjects perceives the cooperative option as the fairest outcome in all four prisoner's dilemma games (VLOW 94%, LOW 96%, MEDIUM 88%, HIGH 97%), independent of the treatment condition.

Based on the analysis of response times and choice frequencies in the Unconstrained condition, the only PD game that can shed light on the FII hypothesis is the LOW game. The fraction of cooperative "fair" choices in the LOW game increases from 41% in the TD condition to 44% in the TP and 50% in the STP condition. This increase is not statistically significant though (Two-sided Fisher's exact test; TD vs. TP: $p = 0.74$, TD vs. STP: $p = 0.39$). When we restrict our analysis to choices on the first decision screen (TD: 69% vs. TP: 60% vs. STP: 50%) we again find no evidence that time pressure increases the fraction of fair behavior but rather observe a slight decrease (Two-sided Fisher's exact test; TD vs. TP: $p = 0.73$, TD vs. STP: $p = 0.43$). Given that in the LOW game the FII and the DDM both predict that time pressure should increase the fraction of fair choices, this observation is unambiguous evidence against the hypothesis that "fairness is intuitive" and the findings in Rand et al. (2012).

One potential concern is that our time pressure manipulation could have affected beliefs. If subjects were more optimistic about average contributions of others in the Time Delay compared to the Time Pressure or Strong Time Pressure condition, we might have observed no evidence in favor of the FII hypothesis for this reason. To address this concern, we compare the stated beliefs. We find that in the LOW game, average beliefs did not differ between the two conditions (Rank-sum test; TD vs. TP: $p = 0.63$, TD vs. STP: $p = 1$).

In a second step, we analyze the within-subject effect of time pressure on choices in the LOW prisoner's dilemma game. For this purpose, we compute switching probabilities by comparing a subject's first choice with her second choice in the same game. If fairness was indeed intuitive, we would expect that more subjects initially choose to cooperate under time pressure and switch to defection under time delay. Note that the DDM makes the same prediction. Thus, if we do not observe the expected switching pattern, this would constitute unambiguous evidence against the FII hypothesis.

The first thing to note is that subjects in the TP and STP conditions are indeed more likely to switch from cooperation under time pressure to defection under time delay (Sign Rank Test; TP $p = 0.07$, STP 0.01). Subjects in the TD condition are also more likely to switch from cooperation to defection, but this difference is not significant (Sign Rank Test; $p = 0.2$). When we compare switching behavior in each of the two Time Pressure to switching behavior in the Time Delay condition, we do not find that subjects in either of the two time pressure conditions were more likely to switch from cooperation to defection as compared to subjects in the Time Delay condition (Rank-sum test; TD vs. TP:

$p = 0.62$, TD vs. STP: $p = 0.12$). Hence, instead of reflecting a reassessment of an initial intuitive decision, the decline of cooperative choices in the Time Pressure conditions might simply reflect the well-known fact that subjects tend to become more selfish in repeated decisions even without receiving feedback (Ledyard, 1994). Therefore, our within-subject evidence in in this game does not support the FII hypothesis.

Like in the BD games, a complementary analysis of conditional switching patterns at the individual level shows that most switches occur in games in which subjects are close to their indifference point. These observations support the idea that switching behavior under time pressure reflects choice difficulty instead of a reassessment of an intuitive fair choice.[24]

Result 3 (Between- and within-subject evidence in the PDs) *In the Prisoner's dilemma games, we do not find evidence that time pressure increases the fraction of fair choices even when both the FII as well as the DDM would support this prediction (LOW game). Within-subjects, we find that subjects in both Time Pressure conditions are as likely to revise an initially fair choice as subjects in the Time Delay condition. Both results are inconsistent with the FII hypothesis.*

5 Conclusion and Discussion

In this paper we propose and conduct a new test of the FII hypothesis (Rand et al., 2012; Cappelen et al., 2016). Our test takes into account that a causal test of this hypothesis, using time pressure and time delay manipulations, needs to account for the subjective difficulty of making a choice. We use a simple version of the Drift Diffusion Model (DDM) to show that time pressure can increase or decrease the frequency of fair choices, depending on whether decision makers who prefer the fair option perceive smaller or larger utility differences than decision makers who prefer the selfish option and depending on the distribution of preference types within the population. Hence, these predicted effects may either be aligned with those of the FII hypothesis or affect choices under time pressure in the opposite direction. In our experiment, we then analyze the effect of time pressure in choice situations in which both the DDM and the FII hypothesis predict that time pressure should increase the fraction of fair choices. In neither of the BD or PD games classified accordingly, we find that time pressure consistently increases the fraction of fair choices. On the other hand, we do not find that time pressure increases the fraction of fair choices in games, in which this increase is only predicted by the FII

[24]The full analysis of the remaining games and switching patterns can be found in Appendix C.

hypothesis, thus rendering unambiguous evidence against the FII hypothesis. Our empirical test therefore provides little support for the hypothesis that "fairness is intuitive" in a general way. This result holds between- and within-subjects. A complementary analysis further demonstrates that switching patterns strongly reflect choice difficulty (subjective indifference), a pattern that is supported by the DDM but not by the FFI hypothesis.

On the one hand our rejection of the FII hypothesis is in line with a number of recent papers (Fiedler et al., 2013; Tinghög et al., 2013; Martinsson et al., 2014; Duffy and Smith, 2014; Verkoeijen and Bouwmeester, 2014; Achtziger et al., 2015; Kocher et al., 2016; Lohse, 2016; Capraro and Cococcioni, 2016; Tinghög et al., 2016) and a large scale replication project (Bouwmeester et al., 2017) which also suggest that in some instances behaving fairly might not be intuitive and might even require additional deliberation or stronger self-control. On the other hand, our results are surprising at least to the degree that they contradict a significant number of previous studies which tend to find that time pressure or other forms of inducing intuitive decision making lead to more cooperative or fair choices. For instance, a recent meta-study finds that relying on intuition relative to deliberation increases the average rate of cooperation by 6.1 percentage points in one-shot games (Rand et al., 2016). Similarly, several current theories on the link between intuition and pro-social behavior are based on the idea that deliberation can never increase cooperation (Dreber et al., 2014; Rand et al., 2014; Bear and Rand, 2016)[25]. The observation that some experiments have found an increase of fairness under time pressure while other experiments report no effect or even a reduction of fairness could well be in line with our theoretical considerations because none of the previous experiments has explicitly accounted for subjective utility differences. Hence, it is conceivable that some experiments have looked at choice situations where the DDM and the FII predict effects of time pressure which go in the same direction while other experiments have looked at choice situations in which the DDM and the FII hypothesis make opposite predictions. The most obvious reason for such differences is the choice of the experimental task or its parameters. But even in experiments that analyze the same game (e.g., a public good game with MPCR 0.5) subject pools might differ (e.g., students vs. non-students) and it is possible that subjects with different individual attributes or cultural backgrounds might attach different subjective valuations to options in the same task, thereby leading to unobserved heterogeneity in terms of the perceived choice difficulty as well as the share of fair decision makers. Given that both of these factors determine if the DDM predicts an increase or decrease of fair behavior under time pressure, these experiments might come to different conclusions

[25]For a discussion of the last paper see Myrseth and Wollbrant (2016) and Jagau and van Veelen (2017).

concerning the FII hypothesis.

At this point it is also important to stress that our paper does not attempt to directly replicate previous test of the FII hypothesis or pinpoint any other moderating factor (e.g. confusion, experience, social value orientation, default options) that might also affect the direction of a time pressure effect. Rather, we aim at pointing out that it is unclear whether previous tests provide ambiguous or unambiguous evidence in favor of or against the FII hypothesis, since they do not account for subjective utility differences. Therefore our test differs from these previous tests of the same hypothesis along several dimensions that are motivated by our theoretical considerations: in our test subjects were confronted with several one-shot choice situations instead of only one, the specifics of each choice situation were only revealed on the decision screen and not on a preceding instruction screen[26], stakes were considerably higher than in many of the previous internet experiments, we used a graphical interface to visualize the payoffs of the different choice options and the compliance with the response time manipulations was more strongly enforced and consequently substantially higher. We believe that each of these design changes was well motivated and necessary in order to provide an unbiased test of the FII hypothesis. Furthermore, none of these changes should make it less likely to find evidence in favor of the FII hypothesis in an obvious way if it was generally valid as suggested by the mechanism motivating the social heuristics hypothesis (Rand et al., 2014).

Overall our results suggest that the link between intuition and fairness is more complicated and nuanced than previously thought. A closer inspection of further moderating factors might provide useful insights into the conditions or individual attributes that influence the link between intuition and fairness. Several recent contributions have already provided first insights into the role of confusion (Recalde et al., 2014; Stromland et al., 2016; Goeschl and Lohse, 2016), gender (Rand et al., 2016; Tinghög et al., 2016), culture (Nishi et al., 2017), stake size (Mrkva, 2017) and social-value-orientation (Chen and Fischbacher, 2015; Mischkowski and Glöckner, 2016).

[26]This is in line with Fiedler et al. (2013) and Capraro and Cococcioni (2016) but differs from (Rand et al., 2012). We, however, believe that giving subjects a possibility to fully deliberate on a task before entering the decision screen will affect the chances of isolating intuitive tendencies via time pressure.

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Appendix A: Model and Predictions

In this Appendix, we will describe the Drift Diffusion Model (DDM), introduced in section 2, in more detail. This description will derive the following three predictions from the DDM: First, the higher the (absolute) subjective utility difference between the options of choice, the lower a decision maker's expected response time. Second, a decision maker is more likely to make a mistake (i.e. to choose the option that yields a lower subjective utility) the smaller the utility difference between the two options of choice. Third, a decision makers is more likely to make a mistake under time pressure the smaller the utility difference between the two options of choice.

The first two predictions are common in the DDM literature and have previously been used to show that the *correlation* between response times and "fair" behavior can reflect subjective utility differences (Krajbich et al., 2014, 2015a,b). The third prediction is novel, at least in the context of the literature on fairness and time pressure, and follows immediately from the second prediction. A set of plausible parameter assumptions furthermore allows us to infer how this individual level prediction affects the aggregate share of fair choices under time pressure and time delay.

For the purpose of illustration, we will refer to a basic version of the DDM. This basic version can be summarized as follows: A decision maker accumulates stochastic information about her preferences for a "fair" (henceforth: F) and a "selfish" (henceforth: S) option over a series of time periods t. We denote the decision maker's true underlying utility value for the fair and the selfish option by $u^i(F) = u_F$ and $u^i(S) = u_S$. Thus, the true underlying utility difference between the fair and the selfish option is $V = u_F - u_S$. In each period t, decision makers observe noisy value signals $F_t \sim \mathcal{N}(u_F, \sigma_F^2)$ and $S_t \sim \mathcal{N}(u_S, \sigma_S^2)$ which are centered around the true means of the underlying value function and which are independently and identically distributed (i.i.d.).

In line with the existing literature (Krajbich et al., 2015a), we will assume that $\sigma_F^2 = \sigma_S^2$, i.e. the distribution functions from which the signals are drawn only differ in their respective means. After observing a pair of signals, the decision maker computes the value difference between the two signals, i.e. $V_t = F_t - S_t$. The stochastic evidence observed until period t is accumulated in a subjective state variable X_t. The accumulation process stops as soon as the state variable X_t crosses an upper threshold a, inducing the decision maker to choose F, or a lower threshold b, inducing the decision maker to choose S. We will follow the convention and assume that the two decision thresholds a and b are equidistant from 0 so that $b = -a$. The evolution of the subjective state variable X_t before hitting either of the decision thresholds in discrete time can be written as:

$$X_t = X_{t-1} + (u_F - u_S) + \epsilon_t = X_{t-1} + V + \epsilon_t \qquad (1)$$

where $\epsilon_t \sim \mathcal{N}(0, \sigma^2)$ captures the noise in the process with

$$X_t \sim \mathcal{N}(tV, t\sigma^2) \tag{2}$$

This simple variant of the DDM can also be modeled in continuous time as a Brownian motion with drift (Ratcliff and Rouder, 1998; Smith, 2000; Bogacz et al., 2006) for which expressions have been derived for the probability of choosing option F for $V > 0$ and the mean response time given that $V \neq 0$ (Palmer et al., 2005; Clithero, 2016)[27]. The probability that a decision maker who prefers the fair option ($V > 0$) actually chooses this option can then be written as:

$$P_F^F = \frac{1}{1 + e^{\frac{-2Va}{\sigma^2}}} \tag{3}$$

As can be easily verified by letting $V \to \infty$ and $V \to 0$, $P_F^F \in [0.5; 1[$.

From expression (3), the probability of choosing the selfish option given that $V > 0$ (i.e. the probability that a fair decision maker chooses the selfish option by mistake) directly follows as

$$P_S^F = 1 - P_F^F \tag{4}$$

so that $P_S^F \in]0; 0.5]$.

The expected number of periods (which is commonly referred to as "response time" in the economics and psychology literature) until one of the thresholds a or b is reached for $V \neq 0$ can furthermore be written as[28]:

$$E[t] = \frac{a}{V} \tanh\left(\frac{aV}{\sigma^2}\right) \tag{5}$$

By symmetry, equations (3) and (4) can be expressed equivalently for the probability that a selfish decision maker with $V < 0$ chooses the fair or the selfish option.

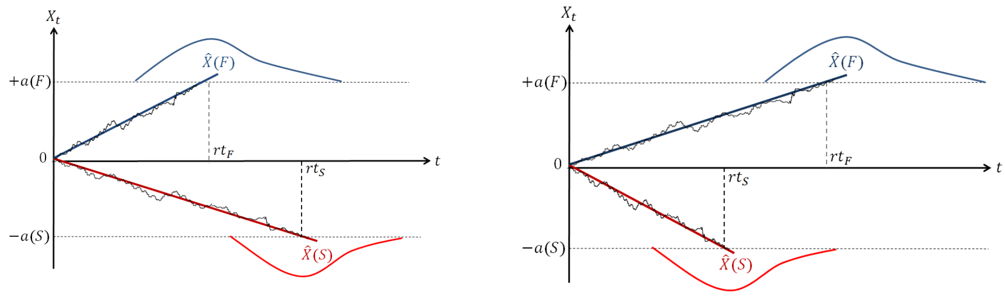
Prediction I

Prediction I states that the expected response time decreases as the absolute utility difference between the fair and the selfish option (i.e. $|V|$) increases. Since the first derivative of equation (5) w.r.t V is strictly negative for $V > 0$, the above statement follows immediately. Assuming symmetrical thresholds and no initial bias, the same is true for $V < 0$.

[27] An additional assumption is that there is no initial bias in favor of one of the two options s.t. $X_0 = 0$.

[28] This expression makes use of the hyperbolic tangent function $\tanh(z) = \frac{e^z + e^{-z}}{e^z - e^{-z}}$

Figure 3 illustrates the relationship between expected response times and $|V|$ and its implications for inferring choice difficulty from response times. We denote the utility difference of fair decision makers as $V_F > 0$, and the utility difference for selfish decision makers will be denoted $V_S < 0$. A direct implication of Prediction I is that fair choices are relatively faster if $V_F > |V_S|$ (see Figure 3a). Similarly, fair choices are expected to be relatively slower, if $V_F < |V_S|$ (see Figure 3b). A direct corollary of this relationship is that arbitrary correlations between fair choices and response times can be created by varying the relative attractiveness of the fair option (Krajbich et al., 2015a).



(a) Fair choices are faster (b) Selfish choices are faster

Figure 3: An illustration of two exemplary processes

Notes: This Figure displays two exemplary Drift Diffusion Processes. $\hat{X}(F)$ ($\hat{X}(S)$) represents the expected evolution of the subjective state variable for the average decision maker with $V > 0$ ($V < 0$) option. Expected response times are labeled as rt_F and rt_S. The actual evolution of the subjective state variable is subject to noise, as characterized by the black lines that fluctuate around $\hat{X}(F)$ and $\hat{X}(S)$. The expected response time distribution of fair choices are displayed above a, the corresponding distribution for selfish choices is displayed below b.

Prediction II

Prediction II states that a decision maker is less likely to make a mistake (i.e. to choose the option that yields the lower subjective utility value) as $|V|$ increases. We will demonstrate this by showing that a decision maker is more likely to choose her truly preferred option as $|V|$ increases. For $V > 0$, this follows immediately from equations (3) and (4). The first derivative of statement (3) w.r.t. V is given by:

$$\frac{\partial P_F^F}{\partial V} = \frac{2ae^{\frac{-2aV}{\sigma^2}}}{\sigma^2(1+e^{\frac{-2aV}{\sigma^2}})^2} > 0 \tag{6}$$

Hence, the probability of choosing the truly preferred fair option increases in V for $V > 0$. As a corollary, using statement (4), P_S^F decreases in V. By symmetry, an equivalent result can be derived for $V < 0$. The intuition behind this prediction is that noise in the decision process will have a larger impact on the value of X_t if $|V|$ is small.

Prediction III

Prediction III states that time pressure will reduce the probability of a decision maker to choose her truly preferred option. We will follow the convention in the psychological literature and model time pressure as leading to a collapse of the decision thresholds a and b to a lower absolute level (Bogacz et al., 2006; Milosavljevic et al., 2010; Hawkins et al., 2015).[29] Intuitively, a lower decision threshold implies that decision makers will choose at lower precision because noise will gain a higher weight in the decision process resulting in a higher likelihood that the wrong threshold is crossed. In the following, we will assume that a decision maker's threshold is A if he is constrained to wait (i.e. $t > t_L$) before making a choice, and $a < A$ if he is constrained to make a fast choice (i.e. $t < t_L$). Hence, A can be re-written as $A = z \cdot a$ with $z > 1$.[30]

Taking the first derivative of equation (3) w.r.t a shows that the probability of choosing the correct option for a given $V > 0$ decreases as a decreases. Using

[29] This assumption allows to base predictions on equation (3). An alternative way to model time pressure would be to analyze the distribution of X_t at different points in time using equation (2) or to analyze the distribution of first barrier passage times from which equations (3) and (5) are derived. The first approach would ignore the presence of decision boundaries. The second approach would rely on an analytical expression for the first passage times with two boundaries $P(T_a \leq t_l) = 1 - (e^{\frac{aV}{\sigma^2}} K_T^{\infty}(a) - e^{\frac{aV}{\sigma^2}} K_T^{\infty}(b))$ as derived e.g. in Smith (2000) or Hieber and Scherer (2012). However, this expression contains the infinite sum $(K_T^N(k) := \frac{\sigma^2\pi}{(a-b)^2} \sum_{n=1}^{N} \frac{(n(-1)^{(n+1)})(e^{(-T(\frac{V^2}{2\sigma^2}+\frac{\sigma^2 n^2 \pi^2}{2(a-b)^2})}) sin(\frac{n\pi k}{a-b})}{\frac{V^2}{2\sigma^2}+\frac{\sigma^2 n^2\pi^2}{2(a-b)^2}})$ for which no closed form solution for the derivative w.r.t V can be found without relying on approximation (Voss et al., 2004; Bogacz et al., 2006).

[30] This approach implicitly assumes that there are sufficient incentives so that all subjects will decide within the time limit, instead of explicitly modeling the choices of subjects who have not crossed the (now lower) decision threshold at t_L. One could e.g. assume that these undecided subjects decide randomly or simply by the sign of the state variable (Bogacz et al., 2006). Both approaches are not opposed to, but would rather strengthen Prediction III as the likelihood of being undecided rises as $|V|$ falls.

equation (4), this implies that higher time pressure causes a decision maker to make more mistakes.

$$\frac{\partial(1-P_F^F)}{\partial a} = -\frac{2ae^{\frac{-2aV}{\sigma^2}}}{\sigma^2(1+e^{\frac{-2aV}{\sigma^2}})^2} < 0 \tag{7}$$

Hence, a direct corollary of Predictions II and III is that time pressure will lead to a higher frequency of mistakes among decision makers with smaller $|V|$. To see this intuitively, compare two decision makers and assume that $V_F > |V_S|$. In this case, selfish decision makers are more likely to cross the wrong decision threshold compared to fair decision makers when they have to take a decision under time pressure.

Aggregate choice frequencies

We will use the results of Predictions II and III to show how aggregate choice frequencies respond to time pressure and time delay. Let α be the fraction of decision makers who prefer the fair option ($V > 0$), and $1-\alpha$ be the fraction of decision makers who prefer the selfish option ($V < 0$). Furthermore, let $P_k^m(V,a)$ be a function that describes the probability of a decision maker of type $k \in \{F,S\}$ to choose an option $m \in \{F,S\}$ using equations (3) and (4). As described above, we assume that time pressure leads to a collapse of the decision thresholds, i.e. the decision threshold is A under time delay and $a < A$ under time pressure such that $A = z \cdot a$ with $z > 1$. We will look at a case where $V_F > |V_S|$. We write $V_F > l \cdot |V_s|$ with $l > 1$.

We write for the probability of choosing the fair option under time pressure

$$p_F(a) = \alpha \cdot (P_F^F(V_F,a)) + (1-\alpha) \cdot (P_F^S(V_S,a)) \tag{8}$$

Similarly, the probability of observing a fair choice under time delay is

$$p_F(A) = \alpha \cdot (P_F^F(V_F,A)) + (1-\alpha) \cdot (P_F^S(V_S,A)) \tag{9}$$

Using equations (8) and (9), we can derive the condition under which the fraction of fair choices is higher when the decision threshold is a as compared to A:

$$p_F(a) \geq p_F(A)$$

$$\alpha \cdot (P_F^F(V_F,a)) + (1-\alpha) \cdot (1-P_S^S(V_S,a)) \geq \alpha \cdot (P_F^F(V_F,A)) + (1-\alpha) \cdot (1-P_S^S(V_S,A))$$

This equation can be re-written as

$$(1-\alpha)\cdot(P_S^S(V_S,A)-P_S^S(V_S,a))\geq\alpha\cdot(P_F^F(V_F,A)-P_F^F(V_F,a)) \tag{10}$$

We want to show that this conditions holds if $\alpha < 0.5$ (i.e. when the type with the stronger preference is less common in the population). For $\alpha \leq 0.5$ it suffices to show that

$$P_S^S(V_S,A)-P_S^S(V_S,a) > P_F^F(V_F,A)-P_F^F(V_F,a) \tag{11}$$

because $(1-\alpha)\geq\alpha$ and hence if (11) holds, (10) holds as well.

We re-write equation (11) by plugging in (3). To simplify, we will set $a = 1$ such that $A = z$. In addition, we use $V_F = l \cdot V_S$ with $l > 1$ and define the signal-to-noise ratio as $y = \frac{V}{\sigma^2} > 1$. Thereby, we can re-write equation (11) as

$$\frac{1}{1+e^{-2yz}}-\frac{1}{1+e^{-2y}} > \frac{1}{1+e^{-2lyz}}-\frac{1}{1+e^{-2ly}} \tag{12}$$

This equation states that time pressure leads to a higher frequency of fair choices, if the difference in error rates under time pressure versus time delay is larger for selfish than for fair decision makers.

To further simplify, we will define the following function:

$$g(\lambda,z)=\frac{1}{1+e^{-2\lambda z}}-\frac{1}{1+e^{-2\lambda}} \tag{13}$$

Note that the L.H.S of equation (12) is $g(y,z)$ and the R.H.S. is $g(ly,z)$. Thus, to show that equation (12) holds, we show that $g(\lambda,z)$ is a strictly decreasing function in λ for some reasonable parameter assumptions.

$$\frac{\partial g(\lambda,z)}{\partial\lambda}=2z\frac{1}{(1+e^{-2\lambda z})^2}e^{-2\lambda z}-2\frac{1}{(1+e^{-2\lambda})^2}e^{-2\lambda}<0 \tag{14}$$

This equation can be re-written as:

$$z\frac{(1+e^{-2\lambda})^2}{(1+e^{-2\lambda z})^2}e^{-2\lambda(z-1)}<1 \tag{15}$$

which holds if $\lambda > 1$ and $z > 1$.[31]

[31] More precisely, there exists a λ_0 for which this equation always holds if $\lambda > \lambda_0$ which is a function of z. The bigger z (i.e. the stronger the effects of time pressure) the smaller λ_0 becomes. If we drop the assumption that $a = 1$ this parameter restriction translates to $a \cdot \lambda > 1$. In other words, we have to assume that either the signal to noise ratio y is sufficiently strong or that the decision threshold a is sufficiently large which ensures that decisions are not fully governed by noise. Since we treat the DDM as a model of decision making, it seems reasonable to assume that the average decision maker receives value signals which are strong enough. In addition, our empirical design ensures that time pressure is not extreme, allowing individuals to make non-random decisions. When both z and y become large, note that $g(y,z) \sim g(ly,z)$ so that the difference is mainly reflecting differences in population shares.

This result leads to four predictions depending on the population share α and l.

1. For $\alpha = 0.5$ and $l = 1$ it is easy to verify that the L.H.S. and R.H.S. of equation (10) are exactly equal. This indicates that we would not expect a change in the frequency of fair choices due to the DDM - a case that we have described as a *type 0* ("perfectly balanced") situation in the main text of the paper.

2. For $\alpha \leq 0.5$ and $l > 1$, we have shown above that equation (12) is fulfilled as long as the signal to noise ratio $y > 1$ or the decision threshold a is sufficiently large (or a combination of both). Here, time pressure should increase the fraction of fair choices relative to time delay. We refer to this as a situation of *type 1*.

3. For $\alpha > 0.5$ and $0 < l < 1$, we can derive a reverse statement of equation (12). Here, the DDM predicts that time pressure decreases the fraction of fair choices. We refer to this as a *type 2* situation in the paper.

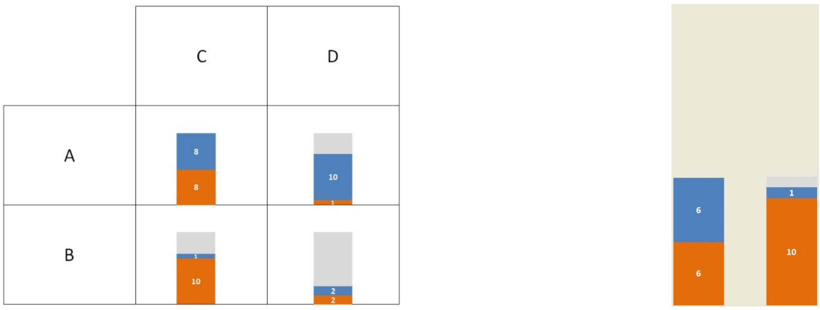
4. For $\alpha > 0.5$ and $l > 1$, it does not suffice to show that equation (12) is fulfilled. As can be seen from equation (10), whether the prediction holds depends on the absolute difference in error probabilities. Hence, without knowing the mistake probabilities under a and A, the DDM does not make clear predictions in these situations. By symmetry, a reverse statement can bee derived for the case where $\alpha < 0.5$ and $0 < l < 1$.

Appendix B: Experimental Details

This part of the Appendix gives additional information about the experiment. Section 1 shows how the games were displayed to the subjects in the experiment. All filler games used in the experiments are depicted in section 2. The instructions are reproduced in section 3.

Visual Presentation of Games

The payoffs associated with each binary choice were displayed graphically as stacked and colored bars in all games (see Figure 4). The subject's own payoff corresponded to the orange and the other participant's payoff to the blue bar in all binary choice situations. Subjects received detailed instructions on how to read the bars and we confirmed their understanding in four control questions before they could start with the actual decision tasks. Furthermore, the examples used for the control questions did not relate to prisoner's dilemma games but displayed arbitrary payoffs to prevent potential priming effects. We believe that this way of displaying the payoffs has two advantages. First, it ensures that participants with different types of preferences can identify and implement their preferred choice with equal difficulty. Second, it makes the payoffs easily accessible and comparable across the choice options, even under response time constraints.



(a) Prisoner's dilemma games (b) Binary dictator games

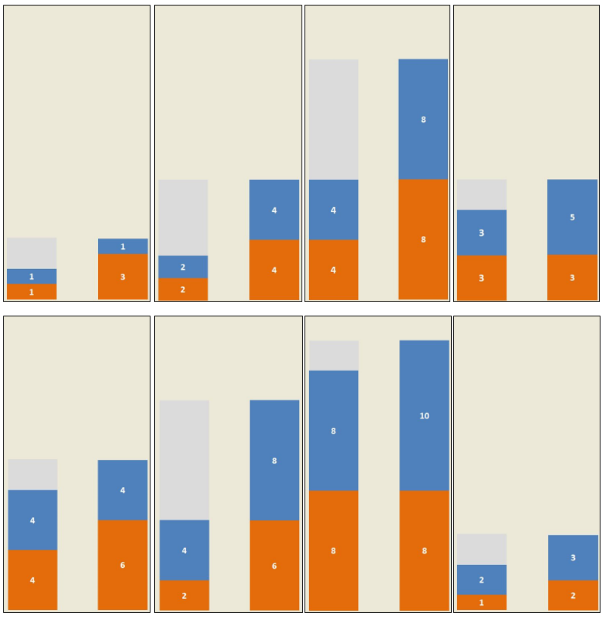
Figure 4: Presentation of games in the experiment

Filler Games

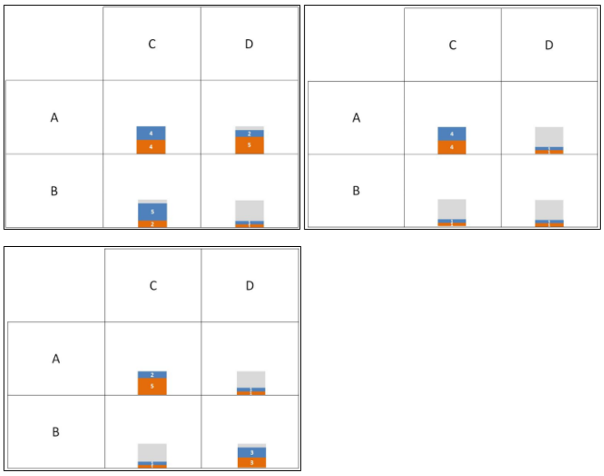
In Figure 5, we display the filler games that subjects faced during the experiment.

Figure 5: Filler Games

(a) Binary Dictator Games (Part 2)



(b) Prisoner's Dilemma Games (Part 1)



Instructions

Instructions were presented on the screens in German language. A translated version of the original instructions is presented below. The original instructions are available upon request.

Instructions for part 1 of the experiment

You will now start with the first part of the experiment.

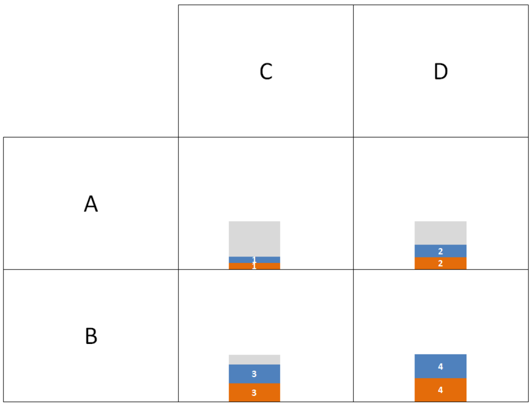
This part of the experiment consists of **10 rounds**.

In each round, you will interact with one other randomly chosen participant. No participant is going to be informed with whom he or she has interacted during the experiment.

Procedure within each round

In each round, both participants **simultaneously** choose one of two options: You decide between option "A" and "B", the other participant decides between option "C" and "D". Hence, you decide between options A and B without knowing which option has been chosen by the other participant.

Your payoff and the payoff of the other participant depend on the decisions of both participants. At the beginning of each round (so before you and the other participant have made a choice), both participants will see a table in which the four different payoffs are displayed.



Each of the four possible payoffs is depicted as a bar chart. The bars consist of several coloured parts.

Your own payoff corresponds to the orange part of the bar. The number within the orange part of the bar indicates the exact Euro amount that you will going to receive in that case.
The payoff of the other participant corresponds to the blue part of the bar. The number within the blue part of the bar indicates the exact Euro amount that the other participant is going to receive in that case.

The height of the orange and the blue part corresponds to the sum of payoffs for both participants. The grey part of the bar indicates the payoff difference to the maximum achievable sum in this round.

Examples:

Example 1:

You have chosen option A, the other participant has chosen option C. This results in the following payoffs: You receive 1 Euro and the other participant receives 1 Euro.

Example 2:

You have chosen option B, the other participant has chosen option D. This results in the following payoffs: You receive 4 Euro and the other participant receives 4 Euro.

Please note

The actual payoff table is going to **look different** in the experiment. Also, the payoffs will differ in each round.

End of a round

The round is over as soon as both participant have taken a decision. You **will not be informed** about the choices of the other participant.

Your payoff

At the end of the experiment the computer will randomly **choose one round from this or the other part of the experiment. You receive the amount which results from your own and the decision of the other participant.** Hence, each decision in this part of the experiment can influence your final payoff at the end of the experiment

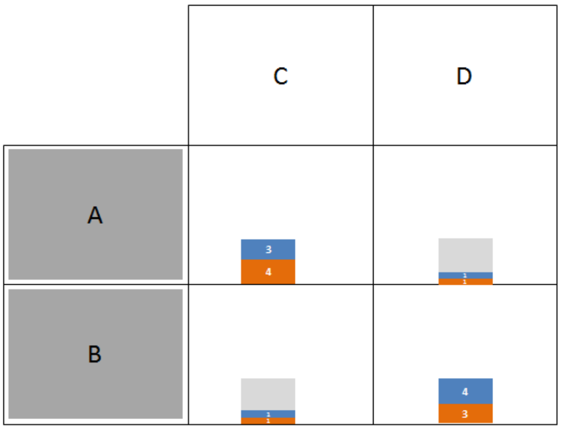
You have received all instructions for the first part of the experiment now. Press "continue" to learn more about how each choice will be displayed on your computer and to test your comprehension on an example.

<u>Screen:</u>

Example

In this part you can test your comprehension using the payoff table displayed below. Your choices in this part will not influence your final payoff.

Please look at the payoffs displayed in the table:



Question 1:

Suppose you choose option A and the other participant chooses option C.

Your payoff in Euro: ____________________
Payoff of the other participant in Euro: ___________

Question 2:

Suppose, you choose option B and the other participant chooses option C.

Your payoff in Euro: ____________________ Euro (1)
Payoff of the other participant in Euro: ___________ Euro (1)

Press “continue“ to find out whether you answered correctly.

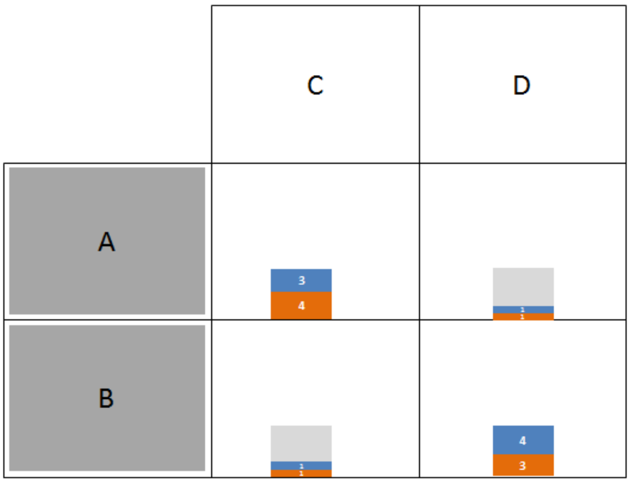
<u>Screen:</u>

<u>Feedback (correct):</u>

You have answered both questions correctly. You can start with round 1 now.

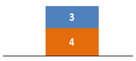
<u>Feedback (wrong):</u>

Unfortunately, you did not answer all questions correctly. Please take a look at the payoffs displayed in the table once more:



<u>Question 1 (wrong):</u>

In question 1 you were asked: What payoff would you and the other participant receive in the case that you would chose option A and the other participant would choose option C. The payoffs are as follows:



In this case you would receive 4 Euro (orange part of the bar). The other participant would receive 3 Euro (blue part of the bar).

Please make sure that you have understood all instructions. If you need further help please contact the experimenter.

<u>Question 2 (wrong):</u>

In question 2 you were asked: What payoff would you and the other participant receive in the case that you would chose option B and the other participant would choose option C. The payoffs are as follows:

In this case you would receive a payoff of 1 Euro (orange part of the bar). The other participant would receive a payoff of 1 Euro (blue part of the bar).

Please make sure that you have understood all instructions correctly. If you still have problems, please contact the experimenter.

Screen:

[Time Pressure]

In the following 5 rounds you should decide quickly.

Please select option A or B in **less than 12 seconds** in every round.

The remaining decision time is displayed above the payoff table.

If your decision takes longer than 12 seconds in one round and if this round is chosen for payoff, you will not receive your show-up fee of 3 Euro.

[Time Delay]

In the following 5 rounds you should wait before making a decision.

In each round you should wait **at least 12** seconds before you decide between options A und B.

Only after 12 seconds have passed, the grey choice buttons labelled "A" and "B" will appear on the screen.

You don't have to decide precisely after 12 seconds. You **can think as long as you want**.

Press "continue" to start with the first round.

Screen:

[Time Pressure]

In the following 5 rounds, there is a **time limit** for your decision.

Suppose, one round from this part of the experiment is chosen. **You receive your show up fee of 3 Euro only if you …**

… took a decision in more than 12 seconds
… took a decision in less than 12 seconds
… took a decision in exactly 12 seconds
… took a decision in less than 20, but more than 12 seconds

… in the randomly chosen round.

Please select the correct answer. On the next screen you will be informed whether your answer was correct.

[Time Delay]

In the following 5 rounds there is a **time limit for your decision.**

In each round you should…

… take a decision in less than 12 seconds.
… wait at least 12 seconds before to take a decision.
… take a decision in exactly 12 seconds
… take a decision in at least 8, but less than <TimePressure|1> seconds to take a decision.

Screen:

Feedback Correct:

You answered the question correctly and can now start with round 1.

Feedback Wrong:

Unfortunately, you haven't answered the question correctly. Please take a look at the following advice again.

[Time Pressure]

In the following 5 rounds you should decide quickly.

Please select option A or B in **less than 12 seconds** in every round.

The remaining decision time is displayed above the payoff table.

If your decision takes longer than 12 seconds in one round and if this round is chosen for payoff, you will not receive your show-up fee of 3 Euro.

[Time Delay]

In the following 5 rounds you should wait before making a decision.

In each round you should wait **at least 12** seconds before you decide between options A and B.

Only after 12 seconds have passed, the grey choice buttons labelled "A" and "B" will appear on the screen.

You don't have to decide precisely after 12 seconds. You **can think as long as you want**.

Press „continue" in order to start with the first round.

Appendix C: Additional Results

Results for Prisoner's Dilemma Games

Table 8: Between-subject comparison of the average rate of fair choices in the prisoner's dilemma games

	Time Delay		Time Pressure		p-Value Fisher's exact	Strong Time Pressure		p-Value Fisher's exact
	N	mean	N	mean		N	mean	
VERY LOW	74	0.30	72	0.44	0.09	30	0.57	0.01
LOW	74	0.41	72	0.44	0.74	30	0.50	0.39
MEDIUM	74	0.43	72	0.53	0.32	30	0.60	0.14
HIGH	74	0.64	72	0.56	0.40	30	0.47	0.13

The mean rate of fair choices displayed is calculated over all orders. We report the result of a two-sided Fisher's exact test comparing the fraction of fair choices in the BD and the TP and STP conditions.

Table 9: Within-subject comparison of switching behavior in the prisoner's dilemma games

	Time Delay			Time Pressure			Rank-sum	St. Time Pressure			Rank-sum
	N	mean	Sign-rank	N	mean	Sign-rank	p-Value	N	mean	Sign-rank	p-Value
	(within-subjects)			*(within-subjects)*			*(across)*	*(within-subjects)*			*(across)*
VLOW	74	0.11	0.05	72	0.28	0.01	0.04	30	0.33	0.01	0.03
LOW	74	0.08	0.20	72	0.13	0.07	0.62	30	0.27	0.01	0.12
MEDIUM	74	0.04	0.53	72	0.31	0.01	0.01	30	0.27	0.02	0.07
HIGH	74	0.19	0.01	72	0.08	0.32	0.38	30	0.07	0.32	0.23

In this table we report the direction of switches for each of the four prisoner's dilemma games. The switching variable takes a value of 1 if the subject switched from cooperation in block 1 to defection in block 2. The decision in block 1 is taken under time pressure in the TP and STP condition and under time delay in the TD condition. The decision in block 2 is taken under time delay in all three conditions. Columns 4 and 7 report the p-Value of a Wilcoxon Sign Rank Test, performed on subject's switching behavior within one condition. In addition, we report the p-Value of a Rank-sum test which compares switching behavior across the TD and TP (column 8) and the STP condition (column 12).

Figure 6: Conditional switching probabilities in the prisoner's dilemma games

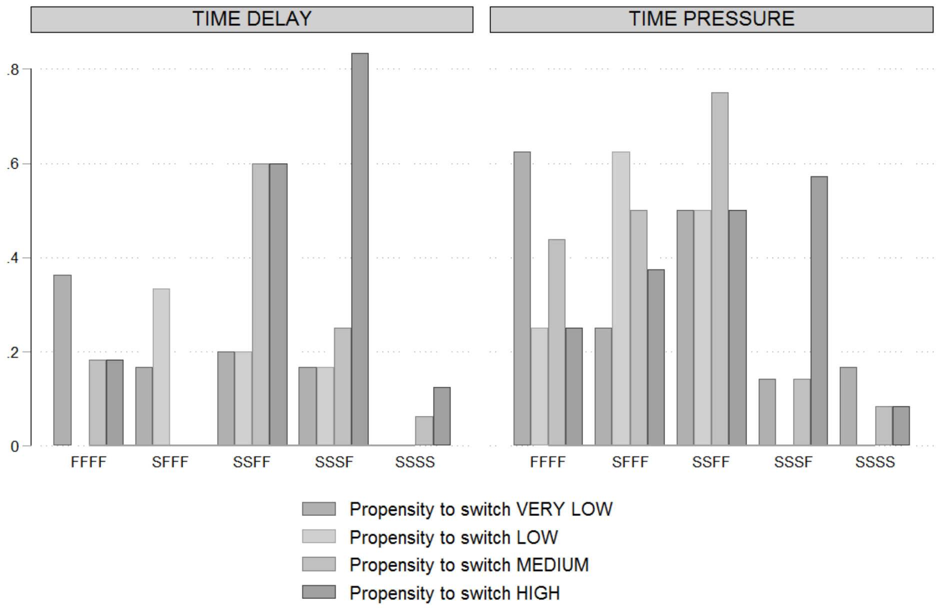


Table 10: Random effects probit regression for the effect of time pressure in the prisoner's dilemma games

	(1)	(2)	(3)
TIME PRESSURE (TP)	0.180	0.546*	0.417
	(0.95)	(1.87)	(1.15)
STRONG TIME PRESSURE (STP)	0.316	0.922**	0.763
	(1.35)	(2.47)	(1.53)
LOW	0.0397	0.394	0.730**
	(0.19)	(1.44)	(2.23)
MEDIUM	0.350*	0.568**	0.938***
	(1.79)	(2.16)	(3.13)
HIGH	0.576****	1.171****	1.181****
	(3.45)	(4.68)	(4.55)
SCREEN2	-0.528***	-0.573***	-1.252****
	(-2.64)	(-2.79)	(-4.56)
SCREEN3	-0.668****	-0.709****	-0.981****
	(-3.89)	(-4.06)	(-3.83)
SCREEN4	-0.777****	-0.728****	-0.786***
	(-4.31)	(-3.99)	(-2.96)
TP * LOW		-0.421	-0.778*
		(-1.21)	(-1.74)
TP * MEDIUM		-0.219	-0.640
		(-0.66)	(-1.49)
TP * HIGH		-0.780**	-0.810**
		(-2.22)	(-2.25)
STP * LOW		-0.662	-1.485**
		(-1.24)	(-2.37)
STP * MEDIUM		-0.294	-1.577**
		(-0.72)	(-2.52)
STP * HIGH		-1.470***	-1.175**
		(-2.90)	(-2.10)
TP * SCREEN2			0.865**
			(2.05)
TP * SCREEN3			0.295
			(0.82)
TP * SCREEN4			0.196
			(0.51)
STP * SCREEN2			1.915***
			(2.93)
STP * SCREEN3			0.845
			(1.48)
STP * SCREEN4			-0.252
			(-0.45)
CONSTANT	0.0532	-0.239	-0.175
	(0.27)	(-1.03)	(-0.67)
Observations	704	704	704
Subjects	176	176	176
Prob > Chi^2	0.0000	0.0000	0.0000

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Response Time Statistics

Figure 7: Response times in the binary dictator games

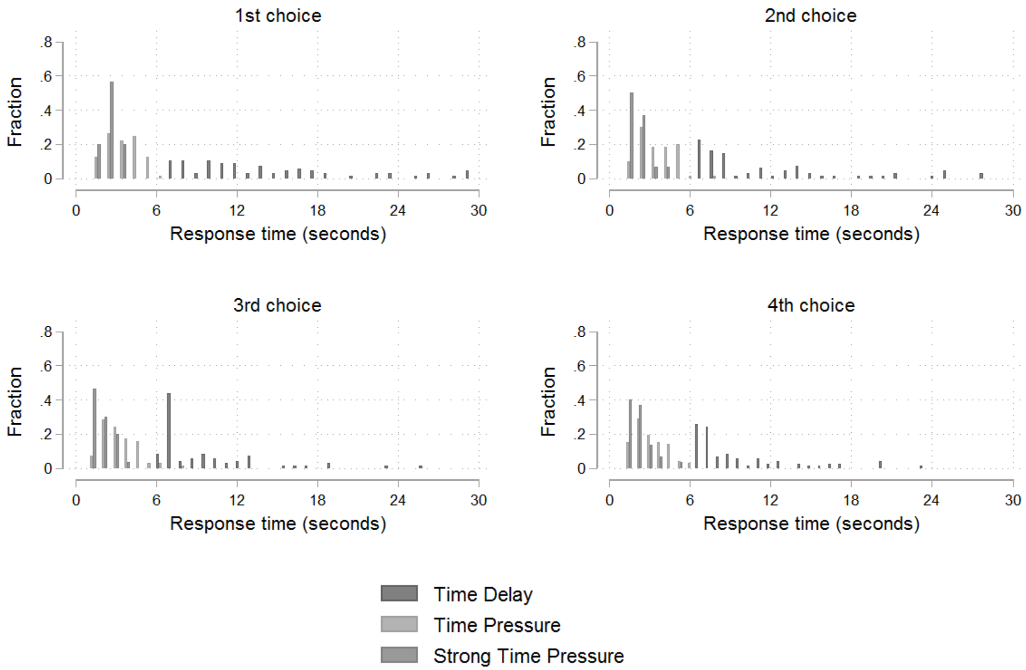


Figure 8: Response times in the prisoner's dilemma games

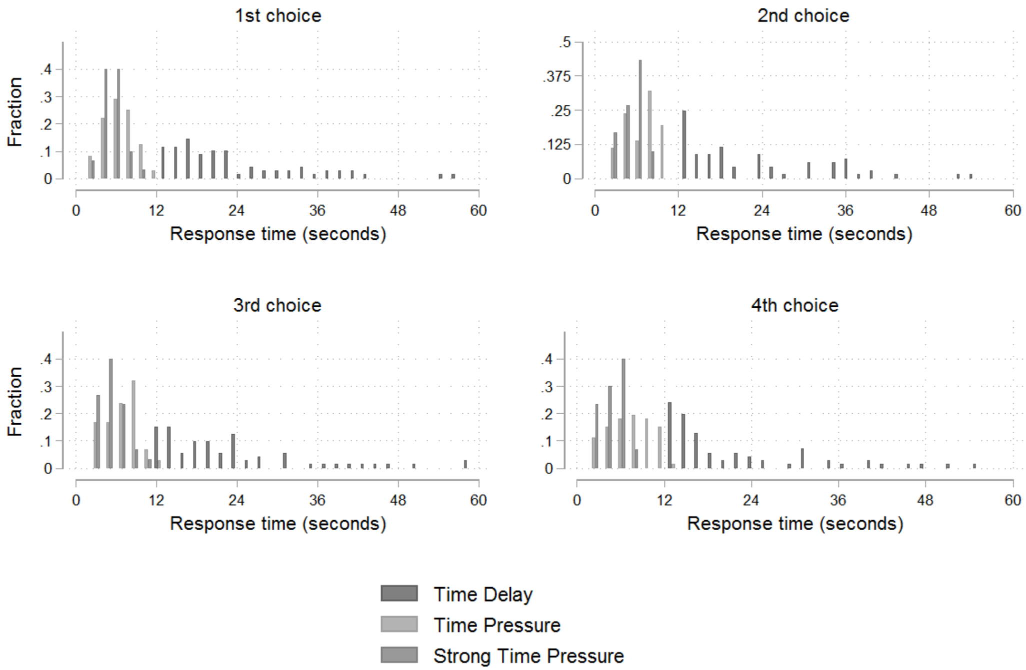


Table 11: Average and maximum response times across all BD Games

	Time Delay		Time Pressure		St.Time Pressure	
	Mean (Max.) Block 1	Mean (Max.) Block 2	Mean (Max.) Block 1	Mean (Max.) Block 2	Mean (Max.) Block 1	Mean (Max.) Block 2
VLOW	17.37 (103.54)	9.86 (30.68)	3.48 (5.98)	11.61 (30.62)	2.51 (3.79)	10.84 (31.11)
LOW	14.72 (64.96)	9.13 (25.20)	3.46 (8.00)	10.32 (36.26)	2.11 (4.42)	10.52 (46.87)
MEDIUM	11.48 (98.36)	7.85 (106.89)	3.21 (7.84)	8.54 (17.40)	1.88 (3.82)	8.76 (27.09)
HIGH	9.79 (23.76)	8.54 (38.98)	2.98 (6.07)	8.18 (29.85)	2.14 (0.32)	7.90 (13.74)

This table shows response time averages for the different BD games across blocks I and II and treatment conditions.

Table 12: Average and maximum response times across all PD Games

	Time Delay		Time Pressure		St.Time Pressure	
	Mean (Max.) Block 1	Mean (Max.) Block 2	Mean (Max.) Block 1	Mean (Max.) Block 2	Mean (Max.) Block 1	Mean (Max.) Block 2
VLOW	28.85 (127.85)	23.25 (87.78)	6.25 (12.46)	26.51 (84.89)	5.31 (8.86)	23.27 (78.98)
LOW	27.57 (108.15)	21.95 (98.54)	6.51 (9.92)	21.08 (62.95)	5.06 (7.58)	18.21 (46.98)
MEDIUM	25.03 (99.21)	25.96 (204.10)	6.75 (12.75)	22.05 (50.87)	4.98 (9.93)	20.68 (75.76)
HIGH	26.14 (243.61)	20.61 (152.516)	7.19 (13.18)	23.66 (63.92)	4.73 (7.79)	22.90 (77.47)

This table shows response time averages for the different PD games across blocks I and II and treatment conditions.