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JEL Classification: C72, C92, D83, D91

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How ex-ante information design affects cognitive conflict and cooperation depending on agents' tendency to cooperate: a mouse tracking study[1]

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Abstract

This study investigates how the design of ex-ante information (given before decisions are taken) affects the cooperative decisions made by team members, depending on their inclination to cooperate. Also analyzed is the effect of this information on cognitive conflict (when an agent internally experiences contrary demands or opposing forces). Moreover, the relationship between cognitive conflict and cooperation is explored. We design an experiment in which participants play 15 rounds, in pairs, of three social dilemmas. The ex-ante information is manipulated in three different ways: displaying only private and individual earnings (the "I" frame); displaying the joint profits (the "We" frame); and displaying both types of information (the "I&We" frame). Mouse movements are tracked using a specific software. Individual inclinations to cooperate are measured using the Honesty-Humility (HH) dimension of the HEXACO personality model. The agents are classified as HH_highs (high tendency to cooperate) and HH_lows (low tendency to cooperate). We measure the cooperation level as the percentage of cooperative decisions and the cognitive conflict level based on the curvature of mouse movements. Ex-ante information design is not found to affect cooperation levels in the case of HH_highs but does affect cognitive conflict levels. The opposite is observed for HH_lows. The main result is therefore that the cooperation of non-cooperative agents can be increased through framing ("I&We" being the best framing). No effect on cognitive conflict is found for HH_lows. Finally, a relationship between cognitive conflict and cooperative decisions for HH_highs is only observed in the case of the "I&We" frame.

JEL codes: C72, C92, D83, D91.

Keywords: cognitive conflict, ex-ante information design, cooperation, HEXACO, mouse tracking

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1. INTRODUCTION

In many disciplines, it is essential to understand how organizations can solve the tension between self-interest and collective interest thus achieving member cooperation. Designing ex-ante information before making decisions plays a pivotal role in boosting cooperation (Cookson, 2002; Sainty, 1999; Rowe, 2004). However, not all agents react to information design in the same way, so it is unclear how information should be presented (Thomas and Thornock, 2021). Moreover, it is not fully understood why agents are affected by the design of ex-ante information. To address these three issues, this study focusses on ex-ante information design, individual characteristics (inclination to cooperate), and cognitive processes (which can help researchers to unravel why information affects agent decision-making differently) (Tank & Farrell, 2021). This study is directed towards determining the ex-ante information design that would encourage typically non-cooperative agents to cooperate, while taking into account their potential harm to organizations and society. Cognitive conflict (which occurs when an agent experiences contrary demands or opposing forces internally) can arise when agents make decisions in a social dilemma context and these decisions differ among individuals presenting different cooperation inclinations (Feixas et al., 2009; Kieslich & Hilbig, 2014, denoted as KH 2014 hereafter). Based on the latter, we also address the question as to whether ex-ante information design has an impact on cognitive conflict, and whether there is a link between this cognitive process and cooperative decisions.

As teams are increasingly used in many organizations, control issues arise, specifically free riding, which results in decreased team cooperation and performance (Kelly & Tan, 2010; Thomas & Thornock, 2021). These types of problems are present in social dilemmas and are especially well reproduced in the Prisoner's Dilemma Game and the Public Goods Game. Those scenarios are useful to represent a variety of organizational settings, where an agent's private interests are at odds with the behavior viewed as desirable by a regulator or manager (Coletti et al., 2005; Dannenberg and Gallier, 2020; Kelly & Tan, 2010; Gomez-Ruiz & Sánchez, 2020; Rowe, 2004). Previous researchers have mainly analyzed, using these games, which is the best way to present ex-post information (that is, information given after the decision is taken) to increase cooperation levels (Coletti et al., 2005; Kelly & Tan, 2010; Nikiforakis, 2010; Rowe, 2004). Nevertheless, we focus on ex-ante information design (information given before making the decision)[2] specifically on the level of the information displayed to agents. Based on framing theory (Nikiforakis, 2010; Rowe, 2004), we analyze whether presenting payoff information at an individual level vs. a group level could influence the agents' cooperation levels, considering that

[2] Therefore, we consider that studies based on ex-post information (e.g., feedback, relative performance information) are not suitable for the present paper.

there is no clear evidence in the literature regarding which frame is the best to enhance cooperation.

To the best of our knowledge, only two studies have focused on analyzing the effect of ex-ante information levels based on framing theory (Cookson, 2000; Rowe, 2004). A framing effect appears when different ways of describing the same choice problem change the decisions that people make, even though the underlying information and choice options remain essentially the same (Cookson, 2000). Cookson (2000) analyzed the effect of ex-ante information levels, manipulating, in a within-subjects design, the payoff matrix in a Public Goods Game. He asked a number of comprehensive questions highlighting an "I" frame (display of individual payoffs) and a "We" frame (display of joint payoffs). Both frames were alternated in the same treatment over four rounds. The author found that agents cooperated more when they received the "We" frame in the last round than when they received the "I" frame. In this line, Rowe (2004) analyzed the effect of the accounting report structure on free-riding behavior in a Public Goods Game. In this study, agents received ex-ante payoff information in two different formats. One format showed the agent's individual earnings only (the "I" frame, i.e., the payoffs), while the other format displayed the individual and joint profits[3]. Contrary to Cookson (2000), Rowe (2004) did not find that ex-ante information levels had a direct effect on the agents' choices. An explanation may be the one-shot design, since participants usually need to experience several rounds in experiments to understand the framework properly. The current study contributes to the previous literature in the sense that only one framing per treatment was considered (in order to avoid mixing the effects of different frameworks as in Crookson, 2000). Moreover, we consider several rounds to allow subjects to build a better understanding of the context. In addition, a full comparison is performed as all three frames were taken into account: the "I" (individual), the "We" (group), and the "I&We" scenarios. We then extended previous studies with the objective of providing clearer evidence of the effect of ex-ante information on cooperation.

It is important to acknowledge that behavior in teams is affected not only by the work context, but also by team members characteristics (KH 2014; Rand et al., 2012; Thomas & Thornock, 2021). In fact, the study by Thomas and Thornock (2021) showed that feedback (ex-post) design affected only pro-self-agents (which are more self-regarding than other-regarding), not pro-social agents. The Honesty-Humility (HH) dimension of the HEXACO model of personality structure has been consistently linked to cooperation in social dilemmas, as evidenced by previous studies (Hilbig et al., 2012; KH 2014; Hilbig et al., 2018; Zettler et al., 2013). HH is defined as the "tendency to be fair and genuine in dealing with others, in the sense of cooperating with others

[3] We label it as "I&We" frame since it shows the information of "I" and the "We" frame together.

even when one might exploit them without suffering retaliation" (Ashton & Lee, 2007, p. 156). HH can determine whether agents tend to cooperate (high HH levels), or defect (low HH levels) and the study by Thomas and Thornock (2021) showed that only pro-self agents were affected by ex-post information. Therefore, our analysis focuses on whether ex-ante information design affects agents with a distinct tendency to cooperate differently. We thus center on whether ex-ante information design could influence cooperation decisions in different ways according to whether agents with low HH levels (HH_lows) or high HH levels (HH_highs) [4].

HH has also been related to cognitive conflict in social dilemmas, but to varying degrees depending on individual features. Cognitive conflict occurs in everyday life in diverse situations. For example, an employer might ask an employee to do something that contradicts the employee's core belief system. A social dilemma context is characterized by a decision where the agent must choose between his/her individual interest vs. a group/collective interest. Thus, the agent can experience cognitive conflict as a result of this situation (Dawes, 1980; KH, 2014). The study by KH 2014 showed that HH_highs suffer a significantly larger cognitive conflict when choosing defect than cooperate. A smaller, opposite effect was found for HH_lows though it was not significant. KH 2014's study also showed that agents react differently to social dilemma situations depending on their HH level (HH_highs cooperate more than HH_lows). Surprisingly, KH (2014) did not find a relationship between cooperative decisions and cognitive conflict levels.

Based on all the above, the study objective is threefold. First, our main goal is to determine whether the ex-ante information design affects agents differently depending on their HH levels, and whether the information design could enhance the cooperativeness of HH_lows. Moreover, following KH 2014's analysis, we also focus on the effect of ex-ante information on cognitive conflict, and whether this effect varies depending on the agents' HH levels. Finally, the relationship between cognitive conflict and cooperation is examined, taking into account its complexity and uncertainty (Emonds et al., 2012; Galluccio & Beck, 2015; KH, 2014).

To achieve these goals, we design a 3 x 15 experiment. The independent variable is the design of ex-ante information, manipulated through the payoff matrix format of the social dilemma: individual earnings (I frame), joint profits[5] (We frame), and individual earnings as well as joint profits (I&We frame). We replicate KH 2014 study for the same three social dilemma games characterized by binary decisions (cooperation vs. defection). The task encompasses 5 rounds of each game with different payoff parameters, and the subjects were randomly rematched at each

[4] The tendency to cooperate or defect is related to the Honesty-Humility (HH) factor of the HEXACO personality model (Ashton & Lee, 2009). The labels "HH_highs" and "HH_lows" have been defined by the authors of the present work for an easier reading.

[5] Joint profits differ from joint earnings, which include the cost of the decision. This difference will be explained in more detail in the Experimental Design section.

round (3 games x 5 rounds: 15 rounds). There is no feedback after each round. Following KH 2014, the inclination to cooperate is measured using the HH factor of the HEXACO personality questionnaire (Ashton & Lee, 2009). One of the explanatory variables is the cognitive conflict level, which is measured through the mean deviation of mouse trajectories to the fastest path towards the final decision. We adopt the mouse-tracking method used in previous studies because it is more capable of capturing the complexity of the cognitive processes underlying conflict (such as in social dilemma situations) (Freeman & Ambady, 2010; KH 2014; Potamianou & Bryce, 2024). The second dependent variable is cooperation level. Our results show that ex-ante information design affects cooperation levels, but this is driven only by HH_lows. In particular, HH_lows cooperate more in the case of the "I&We" frame than in the "I" or "We" frames. Our second result is that the ex-ante information design affects cognitive conflict levels, but this is now driven only by HH_highs. Specifically, HH_highs suffer more cognitive conflict with the "I" frame than with the "I&We" or "We" frames. Importantly, the ex-ante information design does not affect the cooperation levels among HH_highs. Finally, we find a significant relationship between cognitive conflict and cooperation levels, but only for HH_highs in the "I&We" frame. The sign of this relationship depends on the game type.

We expect to make a threefold contribution to previous research. First, adding to the economics and management literature, we show how ex-ante information design, which refers to the displayed information levels, influences the agents' cooperation decisions, and how this effect is moderated by individual features (i.e., inclination to cooperate or to defect). Organizations would be able to use our findings to motivate agents with defect tendencies to cooperate, which are who require improvement. Second, our results highlight the importance of studies based on behavioral and neurophysiological methods, such as mouse tracking, to understand the decision-making during the process (Eskenazi et al., 2016; Hausfeld, von Hesler & Goldlücke, 2024; Ličen et al., 2016; Tank & Farrell, 2021). In order to explain the relationship between information (causes or stimulus) and agent behaviors (output), the present study expands the focus to include cognitive conflict, using the mouse tracking method (Ashton & Lee, 2009; Tank & Farrell, 2021). Third, to the best of our knowledge, the present work is the first to examine the relationship between cognitive conflict and cooperation under different ex-ante information frameworks. We find a connection only in the case of HH_highs in the "I&We" framework. Our findings support previous research results, demonstrating that this relationship is complex and can be influenced by various factors, such as the game type which can reproduce various contextual situations (KH, 2014).

The remainder of the paper is organized as follows. The hypotheses are developed in next section below and the experiment design is outlined in the third section three. The results are presented in section four and our conclusions in the fifth section.

2. RESEARCH HYPOTHESIS

We argue that cognitive conflict levels and the cooperative decisions in social dilemmas vary according to the ex-ante information design and the team members' individual features, as well as between HH_lows and HH_highs. Different hypotheses regarding agents with low and high HH values will be examined, and a hypothesis will be put forward concerning the relationship between cognitive conflict and cooperation.

To ensure that all the situations examined in previous studies were included, the analysis involves three different types of ex-ante information levels: the "I" frame, in which only individual payoff information is provided; the "We" frame, in which only the group payoff is displayed; and finally, the combination of the previous two, i.e., the "I&We" frame.[6]

2.1 HH_lows and ex-ante information design

Thomas and Thornock (2021) showed that ex-post information only influences the decisions of pro-self agents. It is possible to suggest that these agents share similarities with HH_lows. Following this reasoning, we proposed that the ex-ante information design affects HH_lows decisions on cooperation due to framing effects. In particular, the "I" frame will not affect cooperation levels, because it is aligned with the cooperation tendency of HH_lows. Conversely, the "We" frame will increase the cooperation levels of HH_lows.

Regarding the comparison of the "I&We" frame with the "I" frame, two opposite effects can be expected. On the one hand, the "I&We" frame highlights the individual payoffs which may lead the agent to defect more. Conversely, the "I&We" frame can make the agent conscious of the negative consequences of his decisions on the group's payoffs. Previous studies have shown that priming individuals to think about the negative consequences of selfish behavior can enhance their willingness to cooperate (De Dreu & Gross, 2019; Van Lange et al., 2013). This effect is more pronounced in agents presenting low HH values. In other words, HH_lows can be deterred

[6] A caveat here, only "I" vs "I&We" are compared in our research hypothesis, as well as "We" vs "I&We". The reason is that to obtain a clear comparison between two frameworks, only one feature should change. This is not the case in "I" vs "We", in which, for instance, there are two changes from "I" to "We": the omission of the individual payoffs and the inclusion of the group payoffs.

from acting on their inclinations owing to their awareness of the potential consequences of unethical behavior (Ahston & Lee, 2007). Therefore, in the "I&We" frame, HH_lows are expected to increase cooperation with respect to the "I" frame, since the group's payoffs are only displayed in the "I&We" frame. By contrast, we expect higher cooperation levels in the "We" frame than in the "I&We" frames, since the individual payoffs are only shown in the "I&We" frame, thereby highlighting the individual payoffs and affecting defection decisions.

Next, we focus on the effect of ex-ante information on the cognitive conflict levels of HH_lows. As far as we know, this is the first paper to analyze this issue, so no previous results were available to base our hypothesis on. As mentioned before, the study by KH 2014 shows that the cognitive conflict of HH_lows does not change with their decision to cooperate or defect. Therefore, we did not expect to encounter any framing effect on cognitive conflict for HH_lows.

In summary:

Cooperation:

H1: *Ex-ante information design affects the cooperation levels of HH_lows.*

> *H1a: The cooperation levels of HH_lows will be higher in the "I&We" frame than in the "I" frame.*
>
> *H1b: The cooperation levels of HH_lows will be higher in the "We" frame than in the "I&We" frame.*

Cognitive conflict:

H2: *Ex-ante information design does not affect the cognitive conflict levels of HH_lows.*

2.2 HH_highs and ex-ante information design

Thomas and Thornock (2021) showed that ex-post information does not influence pro-social agent decisions on cooperation. HEXACO researchers posit that agents with high HH dimension values are less likely to be affected by contextual factors (Ashton & Lee, 2007; Hilbig et al., 2018). These agents are characterized by fairness, greed-avoidance, and sincerity. Therefore, we do not expect to find any ex-ante information effect on the cooperation levels of HH_highs.

Regarding cognitive conflict, the study by KH 2014 showed that HH_highs experience more cognitive conflict when choosing to defect than when choosing to cooperate. Based on this previous result, we suggest that ex-ante information design affects the cognitive conflict levels of

HH_highs, contrary to what we can be expected in the case of HH_lows. In line with KH 2014, a higher conflict in HH highs can be expected in the frames that highlight the individual payoffs and therefore promote defection. The individual payoffs are provided in the “I” and in the “I&We” frames. However, agents can become aware of the negative consequences of defection through the use of the “I&We” frame, due to the group’s payoff. We therefore expected a higher cognitive conflict level in the “I” frame than in the “I&We” frame, since the “I” frame promotes more defection than the “I&We” frame. In addition, a higher level of conflict could be foreseen in the “I&We” frame than in the “We” frame, since the individual payoffs are shown only in the “I&We” frame, what goes against agents’ tendency to cooperate.

In summary:

Cooperation:

H3: *Ex-ante information design does not affect the cooperation levels of HH_highs.*

Cognitive conflict:

H4: *Ex-ante information design affects the cognitive conflict levels of HH_highs.*

> *H4a: The cognitive conflict level of HH_highs is higher in the “I” frame than in the “I&We” frame.*
>
> *H4b: The cognitive conflict level of HH_highs is higher in the “I&We” frame than in the “We” frame.*

2.3 The relationship between cognitive conflict and cooperation

When attempting to make the best possible decision, an individual has to weight the options available. The question is whether choosing cooperation in a social dilemma situation is the best possible decision or not. Cooperation could be expected to be positively related to cognitive conflict if it was the best possible decision to alleviate the tension experienced by the agent. Previous studies have attempted to understand this relationship based on fMRI (brain scanner) or on a theoretical perspective, with inconclusive results (Emonds et al., 2015; Galluccio & Beck, 2015). On the other hand, KH (2014) found that the effect of more conflict on defection (compared to cooperation) held for the majority of individuals. Nevertheless, the authors only found significant results regarding this possible positive relationship between cognitive conflict and defection for HH_highs. They also found that “the cooperative option exerted more “pull” on mouse movements in case of defection than the non-cooperative option (defection) did in case of cooperation" (KH, 2014, P.518), but again with no significant results. In their conclusions, KH (2014) suggested that the relationship between cognitive conflict and cooperation (defection) may be influenced by several factors, not only by individual features.

We expected to find a relationship between cognitive conflict and cooperation, depending on individual features, based on previous studies and the fact that cognitive conflict would not influence agents with low HH levels. Given that previous studies have not conclusively established the significance and the sign of this relationship, our last hypothesis is of a general nature.

H5: *There is a relationship between cognitive conflict and cooperation decisions and depends on the HH level.*

3. EXPERIMENTAL DESIGN

We design a 3 x 15 experiment, with one independent variable: the design of ex-ante information (I vs I&We vs We), and 15 rounds. We also measure an individual feature, using the HH dimension based on the HEXACO questionnaire. We replicated the KH 2014 study for three social dilemma games: the prisoner's dilemma game (hereafter PDG), the chicken game (hereafter CHG), and the stag hunt game (hereafter SHG), which are characterized by binary decisions (cooperation vs. defection). We tracked the participants' mouse movements when taking the decision to cooperate or not in the three games. We established 5 rounds for each game, changing the payoffs at each round (see Table A1 in Appendix A for all 15 payoff matrices). All three games represent a social dilemma situation (Van Lange et al., 2013), where the defection option was more attractive than the cooperation option except in SHG where the highest payoffs are attained when both players cooperate. If both agents choose the defect option in PDG and CHG, they will end up worse off than if they choose the cooperation option. Next, Table 1 presents the general structure of all 3 games, where R represents reward (both players cooperate), T is temptation (a player receives the highest payoff by defecting and betraying the other player), S is sucker (the payoff that the cooperative player receives when the other player defects) and P is punishment (both players defect). In the game theory literature (see Rapoport & Chammah, 1965; Vlaev & Chater, 2006), temptation is considered to exist when $T > R$ and fear to exist when $P>S$. In this sense, in the PDG, there is temptation and fear; in the CHG there is temptation but not fear; and in the SHG, there is fear but not temptation. Finally, PDG presents an important feature that is not present in the other two games: the fact that defection is a dominant strategy.

This plays an essential role in the cooperation levels because significantly less cooperation can be expected in PDG than in the other two games (CHG and SHG).

Table 1. Formal payoff structure of the three social dilemma games.

(Player 1\ Player2)	Cooperate	Defect
Cooperate	(R, R)	(S, T)
Defect	(T, S)	(P, P)

Note: R = reward, T = temptation, S = sucker, P = punishment.

Following KH 2014, we constructed five variants of each game, where the cooperation index – the CI index, proposed by Rapoport and Chammah (1965) – incorporated these two factors by dividing the difference between the best payoff a player could receive from cooperating and the worst payoff the player could receive from defecting, by the difference between the best payoff from defecting and the worst payoff from cooperating. CI = (R-P)/(T-S)) was held constant, but only the specific values could vary. The higher the CI index, the more attractive the cooperation option.

We measured 15 participant observations, considering that they played three different games based on five distinct payoff matrices. Moreover, the pairs were randomly rematched after every round, and no decision feedback was given to them after each round (which avoided the adoption of reciprocity strategies).

3.1. Manipulation and Measurement

The design of the ex-ante information levels was manipulated by the payoff matrix format: individual earnings (I), joint profits (We), and both individual earnings and joint profits (I&We) (see Table 2 for a detailed description of these matrices). To allow participants to estimate their individual earnings, the information had to be equivalent, so we also provided them with the cost function information (see Table 2 below).

Table 2: Example of Individual earnings ("I" frame) and Joint profits ("We" frame)[7]

		The other member's decision	
		High	Low
Your decision	High	70	0
	Low	140	35

"I" frame

		The other member's decision	
		High	Low
Your decision	High	420	280
	Low	280	70

"We" frame

Cost of your decision:

Low cost = 0

High cost = 120

At the beginning of each session and after carefully reading the instructions, participants were required to correctly answer a pre-questionnaire to ensure that they had properly understood the instructions and were able to correctly compute all payoffs (see Appendix B1 for the pre-questionnaire).

We measured the participants' tendency to cooperate through the HEXACO questionnaire. Differences were assessed using the HEXACO-Personality-Inventory Revised version (HEXACO-60) (Ashton & Lee, 2009; KH, 2014). Within this inventory, we were interested in the Honesty-Humility (HH) factor (10 items of 60)[8]. The HH index presents a continuous rank from 0 to 5, where 5 means (in our context) that an individual is highly cooperative and 0 the opposite. The HEXACO questionnaire was administered *before* the laboratory experiment instructions (see Appendix B2 for the HEXACO questionnaire).

We considered two dependent variables: cognitive conflict level and cooperation. On the one hand, cognitive conflict was measured through the mouse trajectories, based on the analysis of response dynamics. Response dynamics is measured by the continuous tracking of mouse movements while agents choose between options that are spatially separated (equidistant) on a screen (i.e. mouse tracking) (Freeman & Ambady, 2010; Kieslich et al., 2020). The curvature degree represents the competition between the two options (cooperation and defection).

[7] The information from the 'I' and 'We' frames is displayed in the "I&We" frame.
[8] https://hexaco.org/ Visit the HEXACO Materials for Researchers webpage.

Therefore, the curvature is taken as a proxy for cognitive conflict level. The mouse trajectory (i.e., the x-, y-coordinates of the cursor) was recorded in order to measure the cognitive conflict level. To statistically test this curvature pattern, we calculated the maximum deviation (MD) for each single trajectory. The MD is defined as the maximum perpendicular deviation between the actual trajectory and its idealized trajectory, which is the straight line connecting the trajectory's starting point and end point (Freeman & Ambady, 2010; KH, 2014). It has been shown in the literature that MD is a good proxy for measuring cognitive conflict in these kinds of experiments (see for instance KH 2014; Potamianou & Bryce, 2024) as opposed to other measures, such as response time or number of direction changes (see for instance, Evans et al., 2015 or Rand et al., 2014). In line with KH 2014, participants were not told that their mouse movements would be recorded.

The agents' decisions determined the cooperation level, with a value of 1 for cooperation and 0 for defection.

To control for heterogeneity in our econometric analysis, participants answered a post questionnaire data at the end of the experiment. Some of the included items were age, gender, and risk aversion. For the complete list of questions see Appendix C.

3.2. Experimental procedures and task description

First, participants were introduced to the structure of the three social dilemma games using a payoff matrix example. In conformity with KH 2014, the outcomes resulting from each combination of the agents' choices were explained in detail. After the instructions, participants played two practice rounds. They were told that they would play fifteen rounds and one of the other participants would be randomly assigned to them as their interaction partner at each round. An emphasis was put on the fact that each pairing was anonymous, and neither player would learn about the decision of the other. Once all rounds were completed, one round was randomly selected for payments.

We used the same mouse tracking design factors as that of KH 2014, because the cognitive conflict measures are affected by the chosen design (for a review, Kieslich et al., 2020). Participants had to click on the start button in the lower center of the screen to ensure that the mouse cursor starting position was comparable across trials. The payoff matrix was placed in the middle of the decision screen. Participants were instructed to choose an option by clicking on the corresponding box (upper left or upper right). To ensure a neutral language, the options were called "Option A" and "Option B", instead of cooperation or defection. The presentation order of the cooperation/defection choice option, that is, either left (Option A) or right (Option B), was counterbalanced across participants to avoid presentation order effects (KH, 2014).

We used a mouse-tracking tool connected to the software z-Tree (Fischbacher, 2007). In order to record and analyze mouse movements and thus measure cognitive conflict, we employed an external executable mouse-tracking tool (i.e., program) (GlobalMouseTracker) from z-Tree which was created by a professional programmer (see Figure 1 for an illustration of how we measured the trajectory in the decision screen). To perform the measurement, it was crucial to save the exact time at which the participants began and ended their decision in the z-Tree-. See Table 3 for a summary of the experimental design.

Figure 1. Trajectory measurement in the decision screen

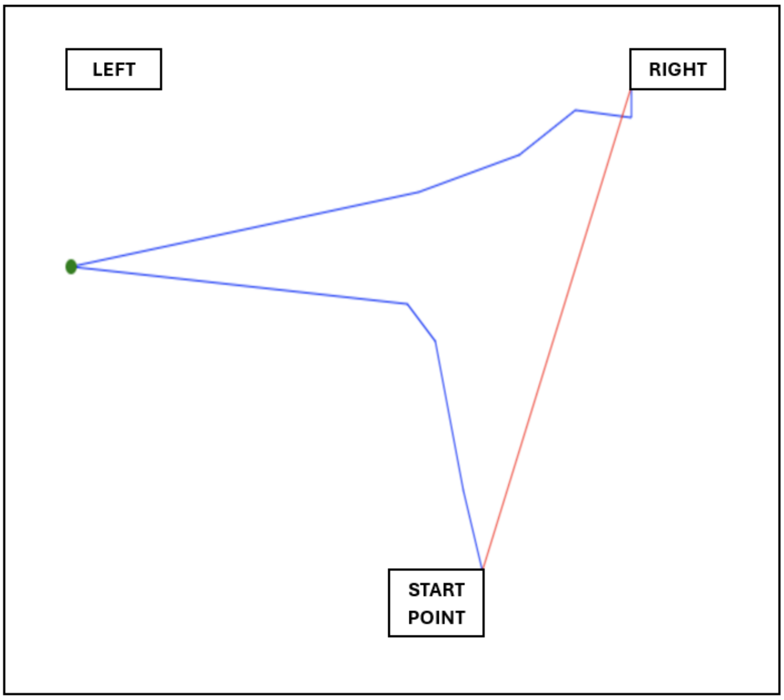


Table 3. Summary of experimental design

Treatments	Players per group	# of rounds	Games (5 rounds each)	Matching	Matrix of payoffs
I frame	2	15	PDG SHG CHG	Strangers	Individual earnings
We frame	2	15	PDG SHG CHG	Strangers	Joint profits
I&We frame	2	15	PDG SHG CHG	Strangers	Individual earnings+ Joint profits

3.3. Participants

Participants in the experiment were 92 graduate students at the University Pablo de Olavide in Spain (32 "I" treatment, 30 "We" treatment, and 30 "I&We" treatment). Their average age was about 22.27 years old, and 51% were female. Participants earned on average of 12.70 € for a 1-hour session.

4. RESULTS

In this section, we begin by presenting the descriptive statistics of our main variables, cooperation levels and cognitive conflict for HH_highs and HH_lows. We then address our hypothesis using parametric analysis. Our tests are two-tailed except indicated otherwise. We also present some supplementary analysis.

Figures 2 and 3 report the descriptive statistics of the cooperation levels (measured as the average percentage of cooperation choices across the 15 rounds) and cognitive conflict (measured as the mean maximum deviation -MD- of the trajectory of the mouse to the shortest path), by treatment (ex-ante information design) and by HH dummy (individual features)[9]. For the HH dummy, we compute the median (3.39) of the whole experiment (that is, pooling all three treatments) and we define HH_highs as those above the median, and HH_lows, as those below the median[10]. We observe that the percentage of HH_low cooperation levels is lower than those of HH_highs across all treatments, although the difference is negligible in the "I&We" frame. Regarding the cognitive conflict, the pattern is quite diverse, in the "I" frame, the HH_highs present more conflict than the HH_lows, and the opposite is found in the "We" frame. As before, the difference is almost negligible in the "I&We" frame.

Figure 2. Cooperation levels by treatment and by individual HH dimension

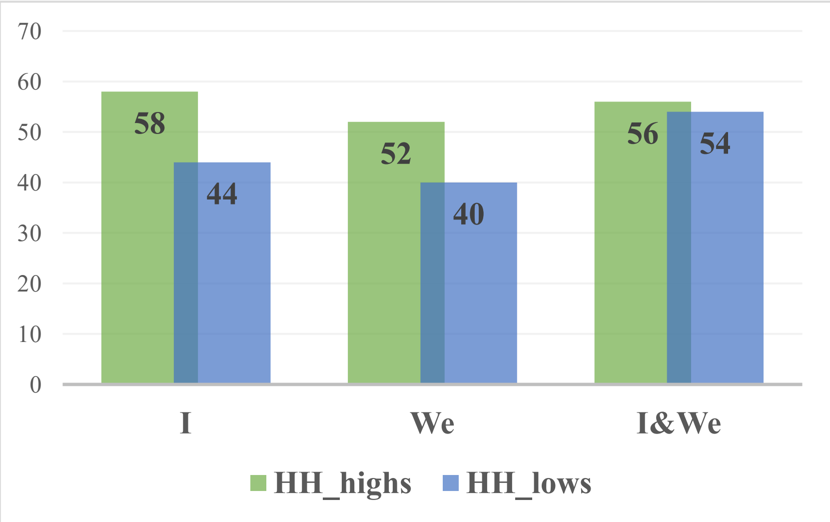
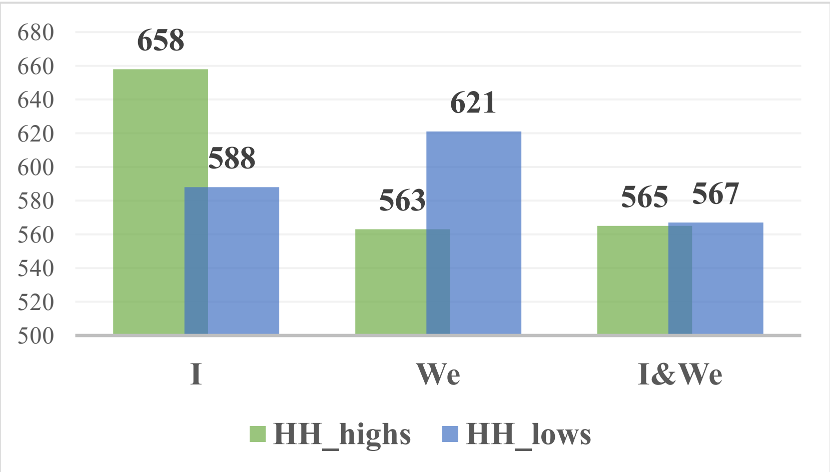


Figure 3. Cognitive conflict levels by treatment and by individual HH dimension



[9] We checked whether the HH dimension could predict cooperation. A t-test analysis was conducted where the cooperation level was the dependent variable and the HH dummy variable (individual features) was the independent variable. The model was significant ($t=1.742$; $p=.041$, one-tailed).

[10] Our results hold if we consider the mean (3.37) instead of the median (3.39).

4.1 Hypothesis tests

4.1.1. Hypotheses 1 and 2 for HH_lows

Table 4 shows the results of the ANOVA model for the dependent variables cooperation (Panel A) and cognitive conflict (MD) (Panel B) for HH_lows. In line with Hypothesis 1, we find statistically significant differences for the cooperation variable ($F = 4.780$, $p < .001$). In the same way, and supporting Hypothesis 2, we did not find statistically significant differences for cognitive conflict levels ($F = 1.770$, $p = .171$) across the three treatments (I, We, I&We)[11].

Table 4: Results of the ANOVA analysis for Hypotheses 1 and 2 for HH_lows

Panel A: ANOVA (N= 46). Dependent variable: Cooperation

	SS	Df	MS	F	*p*-Value
HH_lows	2.354	2	1.177	4.780	.009**

*, **, *** are significant at 10%, 5%, and 1% respectively (two-tailed).

Panel B: ANOVA (N= 46). Dependent variable: Cognitive conflict MD[12]

	SS	Df	MS	F	*p*-Value
HH_lows	343,573.919		171,786.959	1.770	.171

*, **, *** are significant at 10%, 5%, and 1% respectively (two-tailed).

4.1.2. Hypotheses 1a, 1b for HH_lows

The objective of Hypotheses 1a and 1b was to shed light on the best design to increase the cooperation levels of HH_lows. Figure 1 illustrates how HH_low cooperation levels are higher in the "I&We" frame (54%) than in the "I" (44%) or the "We" (40%) frame. We run two t-test analysis (see Table 5) for pairwise comparisons to test Hypotheses 1a and 1b. Hypothesis 1a is supported, because the "I&We" frame encourages higher levels of cooperation than the "I" ($t = -2.207$; $p = .043$). Hypothesis 1b is not supported since cooperation levels in the "We" frame are lower than in the "I&We" frame ($t = -2.971$; $p = .003$). Despite finding a significant effect, the sign is the opposite of what we expected. In sum, the best way to promote cooperation for HH_lows is to use the "I&We" format.

[11] Since the maximum deviation distribution is usually skewed, we also conducted the corresponding tests using the squared root of the maximum deviation and the results are the same for both HH_highs and HH_lows.
[12] We also ran the ANOVA model for the full sample, and we found that the model was significant for both the cognitive conflict (MD) variable ($F = 4.921$; $p = .007$) and the cooperation variable ($F = 3.605$; $p = .027$)

Table 5: T-test analysis (hypothesis 1a and 1b, pairwise comparisons). Dependent variable cooperation (N=46) for HH_lows

	Df	T-stat	*p*-Value
I vs. I&We	351.309	-2.207	.043**
We vs. I&We	463	-2.971	.003**

*, **, *** are significant at 10%, 5%, and 1% respectively (two-tailed).

The results for HH_lows are summarized as follows:

Result 1. ***HH_lows.*** *The ex-ante information affects the level of cooperation. Moreover, cooperation levels are the highest for the "I&We" frame.*

Result 2. ***HH_lows.*** *The ex-ante information does not affect the cognitive conflict.*

4.1.3. Hypotheses 3 and 4 for HH_highs

Table 6 shows the results of the ANOVA model for the dependent variables cooperation (Panel A) and cognitive conflict (MD) (Panel B), for HH_highs. In line with our Hypothesis 3, we find no statistically significant differences in cooperation levels ($F = 1.045$, $p = .352$) among the three treatments (I, I&We, We). And we find support for Hypothesis 4 since the differences for the cognitive conflict (MD) variable are statistically significant ($F = 7.876$, $p < .001$).

Table 6: ANOVA results for Hypotheses 3 and 4 for HH_highs

Panel A: ANOVA (N=46). Dependent variable: Cooperation

	SS	Df	MS	F	*p*-Value
HH_highs	0.517	2	.259	1.045	.352

*, **, *** are significant at 10%, 5%, and 1% respectively (two-tailed).

Panel B: ANOVA (N=46). Dependent variable: Cognitive conflict (MD)

	SS	Df	MS	F	*p*-Value
HH_highs	1537,552.292	2	768,776.146	7.876	<.001***

*, **, *** are significant at 10%, 5%, and 1% respectively (two-tailed).

4.1.4. Hypotheses 4a and 4b for HH_highs

We run two t-test analysis (see Table 7) for pairwise comparisons to test Hypotheses 4a and 4b. First, we compare the cognitive conflict levels in the "I" and the "I&We" frames. The t-test analysis showed significant differences, therefore, the "I" frame implies higher cognitive conflict levels than the "I&We" frame ($t = 3.224$; $p < .001$) for HH_highs and Hypothesis 4a is supported. Then, we compare the "I&We" frame with the "We" frame and we find no significant differences between these two frames regarding cognitive conflict levels ($t = 0.472$; p = e.945). Thus, Hypothesis 4b is not supported.

Table 7: T-test analysis (Hypotheses 4a and 4b, pairwise comparisons). Dependent variable cognitive conflict (MD) (N=46) for HH_highs

	Df	T-stat	*p*-Value
I vs. I&We	358.908	3.224	< .001***
We vs. I&We	386	0.472	.945

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

We summarize our results as follows:

Result 3. ***HH_highs.*** *The ex-ante information does not affect the level of cooperation.*

Result 4. ***HH_highs.*** *The ex-ante information affects the cognitive conflict. Moreover, the cognitive conflict is the highest for the "I" frame.*[13]

Table 8 summarizes the hypotheses as well as the cooperation and cognitive conflict results.

[13] We have replicated Results 1 to 4 considering three categories of HH: HH_lows, HH_medium and HH_highs. See Appendix D for further details.

Table 8: Hypothesis H1-H4 and their associated results

HH Type	Variable	Hypothesis		Result	Test	Supported
HH_lows	Cooperation	H1: Effect	**H1a**: I&We >I	I&We >I	sign.	YES
			H1b: We >I&We	I&We >We	sign.	NO
	Cognitive Conflict	H2:NO effect			n.s.	YES
HH_highs	Cooperation	H3:NO effect			n.s.	YES
	Cognitive Conflict	H4: Effect	**H4a:** I > I&We	I > I&We	sign.	YES
			H4b: I&We >We	I&We =We	n.s.	NO

Note: sign. means significant at least at a 10% level, and n.s. means not significant.

4.1.5. The relationship between cognitive conflict and cooperation

To analyze the relationship between cognitive conflict and cooperation, we first compute the correlation coefficients of these two variables for each treatment and each game and splitting the sample into HH_highs and HH_lows (see Table E1, Panels A and B respectively, in Appendix E).

According to our findings, the relationship between cognitive conflict and cooperation levels varied across different features and contexts. First, in line with our previous results, that is, that cognitive conflict does not change with the ex-ante framing for HH_lows, we find not significant correlation coefficients between cognitive conflict and cooperation (see Table E1, Panel B, in Appendix E). We also encountered a significant and negative relationship (-46%) between cooperation and cognitive conflict in the SHG (high CI) but only in the "I&We" treatment and for HH_highs. We obtain the opposite sign (26%) in the PDG (low CI) (see Table E1, Panel A, in Appendix E). One possible explanation might be that in the SHG, as the CI is high, the cooperative decision is the most attractive, especially for HH_lows, so the cognitive conflict is likely to arise when the "I" frame that highlights the defect option is presented, and therefore, leads to less cooperation. On the other hand, in the PDG, the dominant strategy is to defect, so in this case the cognitive conflict is more likely to be caused by the "We" frame that leads to more cooperation. The former suggests that in the "I&We" frame, the effect of cognitive conflict on cooperation in the SHG for HH_highs is negative, while in the PDG it is negative. We will explore this result further in our econometric analysis.

As cognitive conflict takes place before taking the decision of cooperation, we can conduct a regression to check whether the maximum deviation has an effect on the cooperation levels controlling for other variables[14]. Next Table 9 reports two regressions where we compare cooperation levels in treatments "I" vs "I&We" (specification (1)) and "I&We" vs "We" (specification (2)). As explanatory variables, we use i) MD*I [We] {I&We}, the interaction of the maximum deviation and the I[We] {I&We} treatment dummy; ii) the HH index; iii) age; iv)risk aversion; v) majority_high[15], a dummy variable that is 1 if the subject self-report to have chosen cooperation in the majority of the rounds; vi) type of the game; vii) the period or round and; viii) "I&We" frame, a treatment dummy which is 1 if in the "I&We" treatment and is 0 if in the I [We] treatment.

Table 9. RE Logit regression on the effect of cognitive conflict on cooperation.

VARIABLES	(1) I vs I&We	(2) I&We vs We
MD*I[We]	0.001	0.001
	(0.001)	(0.001)
MD*I&We	**-0.001***	**-0.001****
	(0.001)	(0.001)
HH	0.365*	0.376*
	(0.193)	(0.195)
Age	-0.006	-0.007
	(0.024)	(0.045)
Risk Aversion	0.002	0.006
	(0.003)	(0.004)
Majority high	0.643***	0.0413
	(0.226)	(0.241)
SHG	0.183	0.298
	(0.184)	(0.190)
PDG	**-1.840*****	**-2.316*****
	(0.194)	(0.219)
Period	0.026	0.022
	(0.018)	(0.019)
I&We frame	**0.809****	**1.255*****
	(0.390)	(0.409)
Constant	-1.244	-1.417
	(0.952)	(1.186)
N	900	853

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

[14] In fact, we have conducted some regressions where the dependent variable is MD (cognitive conflict) and the cooperation levels are never significant as explanatory variables. Those regressions are available upon request.
[15] Items iii), iv) and v) were collected in the post-questionnaire.

First, we can observe in Table 9 that the interactions MD*I and MD*We are not significant in specifications (1) and (2), respectively. This means that cognitive conflict has no effect on cooperation levels in the "I" and "We" frames. Nevertheless, in the "I&We" frame, where cooperation levels were the highest (as shown by the positive sign of the "I&We" dummy in both specifications), cognitive conflict (measured as MD) has a negative effect on the cooperation levels. This effect is significant even controlling for the type of player according to the HH dimension. Finally, one can see that the SHG dummy is never significant and the PDG dummy is always negative and significant. That is, the SHG and the CHG (omitted dummy in both specifications) have a similar effect on cooperation levels, while the PDG has a negative effect compared to the other two games. This is not very surprising given that the PDG is the only of those three games in which defect is a dominant strategy. We replicate this result in the next subsection when we split the sample into HH_lows and HH_highs.

Result 5. *Cognitive conflict (measured as Maximum Deviation) has a negative effect on cooperations levels in the PDG and a positive effect in the SHG only in the "I&We" frame for HH_highs. There are no significant cognitive conflict effects in the "I" or the "We" frames.*

4.2. Supplementary analysis

We ran two supplementary analyses: type of game and an econometric analysis.

4.2.1. Type of game

In Appendix F we report the cooperation levels and the cognitive conflict by game. Regarding cooperation, we observe that the higher the CI index the higher the cooperation levels are, but the difference is only significant for PDG (CI = 0.25) with respect to SHG (CI = 2) and CHG (CI = 0.67). Nevertheless, we find that the support for H1 ("I&We" best frame for cooperation for HH_lows) is driven by CHG and SHG, whose CI indexes are high enough to use the HH dimension to predict differences in cooperation decisions. For H3 (HH_highs), we find the same previous result of no effect except in PDG with the "I&We" framing.

Regarding cognitive conflict, we do not find any support for H2 or H4, since we only find an effect on the cognitive conflict for HH_lows in SHG and PDG games, in the sense that the cognitive conflict is significantly higher in the We than in the "I&We" frame in both games. We further explore the effect of the game type in our econometric analysis in the next subsection.

Result 6.

a) *The Prisoner's Dilemma Game has a negative effect on cooperations levels compared to the Stag Hunt Game and the Chicken Game.*
b) *Only in the Stag Hunt Game and the Chicken Game, the "I&We" frame is the best for HH_lows to cooperate. There is no framing effect for HH_lows in the Prisoners' Dilemma Game.*
c) *The cognitive conflict is significantly higher in the "We" than in the "I&We" frames for HH_lows only in the Stag Hunt Game and in the Chicken Game.*

The previous results suggest that to observe an effect on cooperation or cognitive conflict in HH_lows or HH_highs, it is important to obtain a high enough CI index. The latter supports the findings of Zettler et al. (2013).

4.2.2. Econometric analysis

In this section, we conduct an econometric analysis to account for the panel data structure of our sample (notice that averaging observation of 15 rounds leads to substantial information loss) and to control for heterogeneity – that is, individual characteristics that may influence decisions between treatments and that are especially important in laboratory experiments where samples are reduced.

Regarding the dependent variable cooperation, we consider a Random Effects (RE hereafter) logit and we cluster the errors at the individual level. As explained earlier, for the cognitive conflict dependent variable, we use the maximum mouse trajectory deviation to the shortest path (MD) and consider a Generalized Least Squared Model (GLS hereafter). We then cluster the errors at the individual level as well as the group level. The explanatory variables we consider are: i) a dummy for the type of the game (the omitted dummy is the corresponding to the CHG); ii) female, a dummy variable which is 1 if the subject is a woman and 0 otherwise; iii) risk aversion; iv) majority_high; v) the period or round; and vi), "I&We" frame, a treatment dummy which is 1 if in the "I &We" treatment and is 0 if in the I [We] treatment. To achieve a clear comparison between treatments (frames), we performed a pairwise comparison and l therefore include in each specification only the observations of two treatments. First, the "I" observations and then the "I&We" ones. Second, the "I&We" observations and the "We" ones.

Table 10 below reports two RE logit regressions where the dependent variable is the cooperation dummy for HH_lows. Note that the coefficients in the table are marginal effects so their interpretation is straightforward (no transformation is needed). We confirm the results of H1 based on statistical inference. First, as in the hypothesis test, we find support for H1a since cooperation is significantly higher in the "I&We" than in the "I" frame (see that the coefficient of the I&We frame dummy is positive and significant in specification (1)). Also, we obtain the same result as before for H1b, cooperation is higher in the "I&We" than in the "We" frame (that the coefficient of the I&We frame dummy is significant and positive in specification (3)), so H1b is not supported. Finally, we find that cooperation in the PDG is significantly lower than in the CHG (the omitted dummy for type of game) across all specifications. This also confirms that the CI index predicts cooperation levels.

Table 10. RE Logit regressions on cooperation levels for HH_lows

	(1)	(2)
VARIABLES	I vs I&We	I&We vs We
SHG	0.316	0.345
	(0.262)	(0.249)
PDG	-1.682***	-2.304***
	(0.282)	(0.300)
Male	-0.0007	-0.056
	(0.029)	(0.059)
Risk aversion	0.00008	0.0004
	(0.005)	(0.005)
Majority_high	0.741**	0.059
	(0.330)	(0.303)
Period	0.013	0.011
	(0.026)	(0.026)
I&We frame	0.245*	0.793***
	(0.105)	(0.299)
Constant	-0.509	-0.485
	(0.876)	(1.392)
N	420	465

Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Regarding the cognitive conflict for HH_lows (H2), we have run analogous regressions as those in Table 9 and we find no significant effect of any of the two framings considered (maximum p of the treatment dummy = 0.245). So again, we find support for Hypothesis 2 (see Table G1 in Appendix G).

We will now focus on the HH_highs' decisions. To test Hypothesis 3 (cooperation) we have run analogous regression as those in Table 9 but for HH_highs instead of HH_lows (see Table G2 in Appendix G). We find no significant effect of any of the two framings considered (maximum p of the treatment dummy = 0.164), so again, we find support for Hypothesis 3. Moreover, we find a negative effect of PDG on the cooperation levels (respect to CHG or SHG).

Next, Table 11 reports two GLS regressions where the dependent variable is the cognitive conflict (MD) for HH_highs. We confirm the results of Hypothesis 4 using statistic inference. First, we again find support for H4a since there is more conflict in the "I" frame than in the "I&We" frame (see that the that the coefficient of the "I&We" frame dummy is significant and negative in specification (1)). We find support for H4b since the cognitive conflict is significantly higher in the "I&We" frame than in the "We" frame (see that the that the coefficient of the "I&We" frame dummy is significant and positive in specification (2)). Also, observe that the game type has no effect on cognitive conflict. Finally, it is worth noting that males suffer less cognitive conflict than females, but this is only significant for the "I" and "I&We" frames.

Table 11. GLS regressions on Maximum Deviation (cognitive conflict) for HH_highs

VARIABLES	(1) I vs I&We	(2) I&We vs We
SHG	31.58	-57.61
	(32.67)	(39.62)
PD	26.07	-50.37
	(32.67)	(39.65)
Male	-61.54*	29.07
	(36.20)	(51.76)
Risk aversion	0.750*	0.269
	(0.455)	(0.751)
Majority_high	-30.84	-33.69
	(34.03)	(51.02)
Period	-2.292	0.247
	(3.087)	(3.895)
I&We frame	-45.25**	8.491
	(17.65)	(52.21)
Constant	698.4***	563.5***
	(57.17)	(159.4)
N	495	388

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, we conducted some regressions to further explore the effect of cognitive conflict on cooperation levels. We split the sample into HH_lows and HH_highs and we include observations for only one of the frames, since our objective is to check the effect of cognitive conflict on cooperation in one framing at a time. We consider as dependent variable the dummy cooperation and as explanatory variables the same as in previous regression tables except that we add the interaction between the Maximum deviation (MD) and the games SHG and PDG (MD*SHG and MD*PDG, respectively). As suggested by the correlations between cognitive conflict and cooperation, we only find a significant effect in the "I&We" frame. Thus, Table 12 below presents two RE logit regressions for HH_highs and HH_lows only in the "I&We" frame. The regressions corresponding to the "I" and "We" frames are presented in Table G3 in Appendix G.

First, in line with previous results regarding the "I&We" frame, the effect of cognitive conflict on cooperation is never significant for HH_lows in any of the games (see coefficients of MD, MD*SHG and MD*PDG in specification (1) of Table 12). As expected, HH_highs' cognitive conflict has a positive impact in the PDG (see coefficient of MD*PDG in specification (2) of Table 12). Interestingly, overall, the cognitive conflict has a slightly negative effect on cooperation, maybe driven by the negative effect in SHG and CHG with respect to the PDG (see MD coefficient in specification (2) of Table 12). Finally, although we find a cognitive conflict negative impact in SHG as before, this effect is not significant (with respect to the CHG effect which was the omitted game category).

Table 12. RE Logit regressions on the effect of cognitive conflict on cooperation ("I&We")

VARIABLES	(1) **HH_lows**	(2) **HH_highs**
MD*SHG	0.00001	-0.002
	(0.001)	(0.002)
MD*PDG	0.0007	0.005**
	(0.001)	(0.002)
MD	-0.001	-0.002*
	(0.001)	(0.001)
Male	0.902*	0.271
	(0.522)	(1.009)
Risk aversion	-0.0004	0.016
	(0.007)	(0.012)
Majority_high	0.515	0.977
	(0.482)	(0.978)
SHG	0.321	2.405
	(0.881)	(1.655)
PDG	-3.000***	-6.748***
	(0.956)	(1.625)
Period	0.008	0.080
	(0.037)	(0.056)
Constant	0.565	1.055
	(0.941)	(1.164)
N	255	180

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The main findings of the econometric analysis are summarized below under Result 7:

Result 7.

a) *For HH_lows: there is no effect of the ex-ante framing on the cognitive conflict and the "I&We" frame is the one that achieves the highest cooperation levels.*
b) *For HH_highs: there is no effect of the ex-ante framing on cooperation and the "I" frame is the one that entails the highest cognitive conflict.*
c) *For HH_highs: In the "I&We" frame, the effect of the cognitive conflict on cooperation is negative in the Stang Hung Game and in the Chicken Game compared to a positive impact in the Prisoner's Dilemma Game.*
d) *For HH_lows: there is no effect of the cognitive conflict on the cooperation levels.*

5. CONCLUSIONS

In this study, we investigate the effect of ex-ante information design on the agents' cooperation levels in a social dilemma context, and whether this relationship was moderated by the agents' tendency to cooperate. Given that cognitive conflict levels could vary according to individual differences, we also examined the effect of the ex-ante information design on the agents' cognitive conflict. Finally, we analyzed whether there is a relationship between cognitive conflict and cooperation.

Ex-ante information design is observed to have a potential impact on the cooperation decisions only for HH_lows (not for HH_highs). This finding is important, since organizations should be interested in influencing agent behavior which are not aligned with the organizational goals. These results may therefore be highly useful in terms of policy implications, since organizations can improve the cooperation (through the ex-ante information design) of those in the team who usually make less efforts, without affecting the efforts of the more cooperative team members.

Our expectations were not met regarding the best design to influence the behavior of HH_lows. We had anticipated that the "We" frame would boost cooperation the most, but our results revealed that the "I&We" frame was in fact the most effective. Displaying information that makes the agent aware of the pain they can inflict on their peers is found to be more essential than merely displaying information at a group level (the "We" frame).

Relating to the cognitive conflict analysis, in line with our expectations and the findings of KH 2014, ex-ante information design only affected HH_highs. Moreover, we found that the "I" frame generated the highest level of conflict. We did not find significantly different effects between the

“I&We” and the “We” frames. Therefore, it seems that the primary impact of the “I&We” frame is closer to that of cooperative individuals who prioritize the well-being of others.

We also attempted to increase our understanding of the relationship between cognitive conflict and cooperation levels. Our results are in line with the suggestions of KH (2014), that is, that this relationship depends on several features. The relationship was not found to be present for HH_lows. On the contrary, a relationship between cognitive conflict and cooperation exists only for HH_highs and only in the “I&We” frame. However, the sign of this relationship differs between two games, taking a positive sign in the PDG and a negative sign in the SHG. No effect is found in the CHG game. Additional research is therefore required to understand this intricate relationship.

Finally, we explored the possible impact of the game type we considered and in particular, how the cooperation index (CI) could have an impact on our previous results. Our main conclusions are as follows. First, we verified whether, as predictable based on the previous literature, the higher the CI, the higher the cooperation levels (for all three treatments and frames). In fact, our main result that the “I&We” frame is the best frame to induce cooperation in low cooperative agents is only driven by SHG and CHG where the CI index is high enough for the HH_index to predict cooperation decisions.

The current study extends the scope of previous studies which have primarily focused on the effects of ex-ante information design on agents’ cooperation levels, as here, we examine whether individual features could moderate this relationship. Ex-ante information design can have an impact on the decisions of less cooperative agents, so organizations must consider how to present it to prevent free-riding behaviors in a team context. Our results also contribute to the literature on cognitive conflict. Cognitive conflict differences can be explained not only by individual features by also by contextual factors such as ex-ante information design. It is important to note that although cognitive conflict is affected by this design only in the more cooperative agents, the latter do not change their behavior. Therefore, organizations should be conscious that it is not detrimental to provoke cognitive conflict among cooperative agents. Nevertheless, the study was conducted in a laboratory, so caution must be taken when generalizing the results to organizational contexts where the effort is real rather than stated as in our experiment. Moreover, we use a proxy for cognitive conflict and it does not allow to obtain an exact measure (unlike the cooperation level measure which is not approximated). Future studies could extend the current work by conducting a field experiment or using different proxy measures such as the fMRI by Emonds et al. (2015). Due to the unexpected results found, the question remains as to whether the traditional payoff matrix (which displays both the agent and peer earnings) would be more representative of a self-interested frame than our “I” design.

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