Strategic Reasoning and Perspective Taking*

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Abstract

We conduct a lab experiment in Tanzania to investigate whether enhancing perspective-taking improves strategic reasoning. Subjects perform a series of tasks in which they guess a number as close as possible to an anonymous opponent's guess, times a multiplier. We test whether subjects' expectation of their opponent's level of strategic reasoning and their own revealed level of strategic reasoning are affected by (a) receiving written factual information about their opponent and (b) watching a video of their opponent introducing themselves. We find that receiving factual information increases the level of strategic reasoning that subjects expect from their opponent as well as their own, consistent with enhanced perspective-taking. The video per se does not change strategic reasoning, but it enhances the impact of factual information when combined with it. These results suggest that emotive and affective empathy may either facilitate the processing of information that is relevant for strategic reasoning, or enhance perspective taking.

JEL codes: C91, D84, D91.

Keywords: strategic reasoning, perspective taking, empathy, rationality, expectations, bias.

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1 Introduction

Strategic reasoning is central to any economic theory in which agents choose a best response to the anticipated action of others. In order to predict others' actions, economic agents need to form rational beliefs about their behavior, and this, in turn, requires perspective taking, i.e., anticipating the actions of other economic agents by analyzing the incentives they face. Strategic reasoning therefore requires that I put myself 'in the shoes' of others and work out what I would do if I were in their place.

Given how central this assumption is to most economic thinking, we still know relatively little about the extent to which economic agents resort to perspective taking when operating in a strategic setting (e.g., Stahl and Wilson, 1994; 1995; Crawford et al., 2013). The little we know about it in economics is not encouraging. Using a *level-k* expanded two-person version of the beauty contest game to ascertain the strategic sophistication of participants, Costa-Gomes and Crawford (2006) find that most subjects either act as if they assume that their opponent chooses randomly (*level-1*), or they follow no rationalizable pattern and, de facto, act as if they themselves choose randomly (*level-0*) (see also Grosskopf and Nagel (2008); Sbriglia (2008); Fragiadakis et al. (2016)). While these findings may in part be due to a failure in reasoning, insufficient perspective taking is nonetheless suggested by other available evidence. Bursztyn and Yang (2022), for instance, find that "misperceptions about others are widespread, asymmetric, much larger when about out-group members, and are positively associated with one's own attitudes". Sbriglia (2008) shows that informing subjects of the strategic reasoning of other players leads to increased strategic reasoning in subjects – suggesting that they do not do so without being prompted.

Perspective taking has received considerably more attention in the literature on social preferences and altruism (Kalla and Broockman, 2023). In that literature, it has been linked to universalism (Enke et al., 2022) and to empathy (e.g., Krebs, 1975; Davis, 1996; Batson, 2009; Andries et al., 2024) – more specifically to psychological empathy, that is, 'imagining how another is thinking and feeling' (Batson, 2009). Other dimensions of empathy involve affects, emotions, and neurological responses (e.g., facial empathy) (Batson, 2009; Elliott et al., 2011; Stocks and Lishner, 2012). All these different dimensions of empathy tend to be correlated empirically (e.g, Davis, 1996; Batson and Lishner, 2009). In particular, the literature on social preferences has shown that altruistic and egalitarian behavior towards a stranger can be raised by *contact* with that person or someone of the same group (Pettigrew and Tropp, 2006; Paluck et al., 2019). Evidence in favor of the contact hypothesis has been found in a variety of contexts, going from having repeated in-person interactions (e.g., Bretherton, 1992; Bowlby, 1999; Blatt and Levy, 2003; Vaughn et al., 2018; Rao, 2019; Corno et al., 2022; Jia, 2023) to being shown a visual impression (photograph, video, VR) of that person or their group (e.g., Andries et al., 2024). The fact that similar evidence has been found with animals (e.g., Exley and Petrie, 2018) – for whom perspective taking should be less relevant – suggests that contact works at least partly through affective or emotive channels.

The objective of our paper is to test whether a similar effect arises in strategic reasoning. If it does, this indicates that the affective or emotive response triggered by contact extends to perspective taking in games of strategy. Contact, however, may also convey information about strategic intelligence that helps predict behavior in a strategic game. To control for this confound, we design our experiment to disentangle the respective effects of information and empathy on strategic reasoning. This is achieved by cross-cutting a contact treatment – in our case, a video of the opponent – with an information treatment – i.e., proxies for the opponent's strategic intelligence. We also test the effect that these two treatments, either together or separately, have on participants' beliefs regarding their opponent's action (e.g., Gill and Rosokha, 2024). Participants play many different guessing games under different treatment conditions to allow a within-subject implementation of our test.

To be able to assess the effect of the video and information treatments on strategic reasoning, we need an experimental design that can differentiate subjects' actions by their depth of strategic thinking. This is a purpose that is fulfilled by the beauty contest game of Stahl and Wilson (1994; 1995) as generalized by Costa-Gomes and Crawford

(2006). In this game, the action taken by a rational player varies in an identifiable way with the action they believe their opponent will take. Random play is called *level-0*; it signals a failure of strategic reasoning, possibly due to confusion, lack of attention, or the difficulty of the task. A best response to random play is called *level-1*; it is a rational choice if the player ascribes no thought process to their opponent. Put differently, the player may look at the game from the perspective of the opponent but conclude that he or she is not capable of reasoned thought. A *level-2* player is one who chooses a best response to *level-1* and is thus someone who is putting himself or herself 'in the shoes' of a *level-1* player, that is, someone capable of reasoned thought. And so on for higher order *level-k* players. A similar argument can be made for more sophisticated strategies, such as iterated dominance, which also have different levels of strategic reasoning.

The existing literature has shown that, in these beauty contest games, a large fraction of experimental subjects choose rational strategies but there is much heterogeneity in players' decisions (e.g., Crawford et al., 2013; Fragiadakis et al., 2016), implying great diversity in perspective taking. Little is known about what drives these differences and about the mechanisms that lead agents to form more accurate beliefs. If we find that either of our two treatments shifts subjects from low to high levels of strategic reasoning, this will constitute evidence that changes in perspective taking can affect strategic reasoning.

Our laboratory experiment is conducted with students at the University of Dar es Salaam (UDSM), Tanzania. We also elicit subjects' beliefs about the opponents' guesses, which indicate the strategic reasoning level they expect from their opponents. Subjects play twenty-two guessing games with different opponents. Each game is subject to one of four treatment conditions. In the first treatment arm, we provide basic factual information about the opponent in written form – i.e., their gender, GPA, and field of study (i.e., STEM or not).[1] In the second treatment arm, we show a short video of the opponent introducing him/herself and sharing personal information that is easily and broadly relatable ("fun facts"). While the videos are unscripted, their content relates to

[1]STEM stands for Science, Technology, Engineering, and Mathematics.

the opponent's hobbies and interests, a focus that is chosen to trigger a possible affective or emotional attachment while carrying as little information as possible about their strategic intelligence. The third treatment arm combines the two previous treatments and estimates their joint effect. We also include a control condition in which subjects receive no information or video about their opponent.

We find that providing factual information about the opponent significantly increases agents' beliefs about the opponent's level of strategic reasoning and, in turn, players' own level of strategic reasoning. Showing the videos has, on its own, no significant impact on players' beliefs and level of strategic reasoning. When the two treatments are combined, however, the video enhances the impact of the factual information treatment, and the effect of the combined treatment is larger than the effect of the information treatment in isolation. This suggests that the emotive or affective empathy response to the video can enhance agents' ability to make use of factual information that is relevant for strategic reasoning.

This study contributes to the literature on decision-making in strategic settings. While prior research has highlighted the prevalence of heterogeneity in players' decisions and the corresponding diversity in underlying beliefs (Camerer, 2003; Nagel, 1995), little is known about the mechanisms influencing these differences. Our paper focuses on the impact of perspective-taking on decision-making by investigating how beliefs about an opponent's behavior (and, in turn, one's own behavior) are altered by treatments that help a player take the opponent's perspective. By eliciting both agents' level of strategic reasoning and their beliefs about their opponents' level of strategic reasoning, we can study these two separately. In addition, we investigate the mechanisms that trigger perspective-taking: an information treatment that provides insights into the opponent's strategic intelligence, a visual treatment that emphasizes the more affective or emotive side of empathy (Martingano and Konrath, 2022), and the combination of both. Our results confirm that providing information that proxies for an opponent's strategic skill can improve strategic reasoning. More importantly, they also clarify that while, on their own, visual cues are unable to make subjects anticipate more strategic reasoning from their opponent, they can nonetheless reinforce the effect of information on strategy, and that this effect probably occurs via perspective taking

Our study also contributes to a more general literature that examines whether emotions interfere with reasoning. There is evidence suggesting that experimental subjects are more likely to draw invalid inferences in response to emotional compared with neutral statements (Schwarz, 2000; Blanchette and Richards, 2004) and that triggering emotions may impede reasoning (Jung et al., 2014). There is also some evidence suggesting that emotions themselves may be essential to rational thinking and to normal social behavior (Damasio, 2006; Dolan, 2002). Even when emotions interfere with reasoning, they may be essential for humans to invest effort in rational thinking (Loewenstein and Lerner, 2003; Rick and Loewenstein, 2008). Other research suggests that the effect of emotions on rational thinking varies depending on the context, with emotion sometimes hindering normatively correct thinking and sometimes promoting it (Blanchette and Richards, 2010; Blanchette et al., 2017). Our results present additional evidence on the role of emotions in strategic reasoning via perspective taking.

Finally, our work makes a contribution to the debate on perspective-taking as a tool to de-bias opinions (Vescio et al., 2003) and help the public dialogue to become less polarized over a range of domains. The discussion on the effectiveness of such tools is far from settled. It is still unclear, for instance, whether perspective-taking can de-bias people by helping them reflect more accurately on the opponent's motives and choices, or whether it enhances biases by making identity traits more salient, thereby triggering negative stereotypes. It is also unclear whether perspective-taking works by enhancing an agent's factual information set or by triggering an emotional response (e.g., (Martingano and Konrath, 2022)). Our design contributes to this literature by showing that inducing agents to step into their opponents' shoes does indeed improve their decision-making and that such a process works primarily through factual information. Our experimental design does not, however, allow us to parse perspective taking into more nuanced sub-categories, as Kalla and Broockman (2023) have done in the context of exclusionary attitudes and prejudice reduction. More work is needed in this direction.

2 Experimental Design

We conducted an experiment with 200 students of the University of Dar es Salaam. Dar es Salaam University is an ideal context for this study given that it is a relatively young university[2] with a student body characterized by a high level of ethnic and religious diversity – a context potentially less conducive to perspective taking. As such, it is representative of the bustling city of Dar es Salaam, the economic capital of Tanzania, which has grown from less than a million inhabitants in 1978 to more than five million now by attracting migrants from all over a country twice the size of California. These features also make Dar es Salaam and its University representative of much of the Global South. The subject pool, described below, is otherwise akin to students in similar departments across the developed and developing world.

Subjects perform a series of 22 guessing tasks, which consist of guessing *a number as close as possible to an anonymous opponent's guess times a multiplier.* In each task, the player is paired with a new random opponent. This builds on the extended beauty contest game of Costa-Gomes and Crawford (2006). For each task, each participant i is provided with the following information: the lower and upper bounds L_i and U_i for their own guess, their multiplier μ_i, the lower and upper bounds L_j and U_j assigned to their opponent j in the same task, and the multiplier μ_j of their opponent. These parameters change from task to task, but bounds and multipliers are always positive.

Each set of parameters determines a best response guess that depends on the assumption the player makes for their opponent. For instance, if player i has an uninformative prior about what guess player j will make, the best response is to pick the median guess of j – which is $\frac{L_j+U_j}{2}$ –, multiply it by μ_i, and guess $G_i = \mu_i \frac{L_j+U_j}{2}$ if $L_i < G_i < U_i$, or the nearest bound if G_i is outside the allowed range. This strategy is what Costa-Gomes and Crawford (2006) call level-1: it is the best response to an irrational, unpredictable player, called level-0. G_i is, therefore, the optimum strategy for a player i who is rational but unable to project himself or herself 'in the shoes' of player j, and consequently is

[2]Created in 1961 during colonial times, it only came into its own in 1970 when it separated from the Makerere University of Uganda and the University of Nairobi.

unable to imagine what player j might do. A level-2 player j would pick a guess equal to $\mu_j G_i$, while a level-3 player would pick the best response to a level-2 guess, and so on. A guess observed in the experiment is classified as falling in one of these category levels if it is within x units of the benchmark. More precisely, we assign each guess to the level whose benchmark is closest – unless the closest benchmark is more than 10 units away, in which case we assign it to an 'unknown' strategy. If a guess is closest to more than one category, it is assigned to the category with the lowest level of strategic reasoning.

In the original beauty contest game with a common $\mu = 0.5$ and a common range from 0 to 100, the level-1 guess is 0.25, the level-2 guess is 0.125, the level-3 guess is 0.0625, etc. Iterating on level-k reasoning converges to the Nash equilibrium, which is 0. It follows that choosing the Nash equilibrium guess suggests that the subject took more steps in their reasoning about the strategy pursued by their opponent. Optimal guesses based on iterated dominance strategies can be defined in a similarly iterative way – see Costa-Gomes and Crawford (2006) for details. Computing them also involves more steps in the reasoning, which implies that their use indicates more sophisticated perspective taking than the stepwise level-k thinking. In our analysis we focus on the first three levels of level-k thinking, which we denote $L1$, $L2$, and $L3$, and the first three levels of iterated dominance, which we denote $D1$, $D2$, and $D3$, in addition to the Nash equilibrium.

Generalizing the beauty contest game to allow for varying bounds and multipliers produces more separation between $L1$, $L2$, $L3$, $D1$, $D2$, and $D3$ than in the traditional beauty contest: instead of all piling up in the vicinity of 0, they diverge in various directions. This allows more precise inference regarding the type of strategic belief that participants hold. This being said, in the original article by Costa-Gomes and Crawford (2006), the 16 games chosen by the authors contain a lot of overlap between strategies (see Appendix Table A1 for the list of game parameters the authors used). To improve on this design, we initially constructed a more discriminating set of 16 games, each of which only had two overlaps among the seven options considered, and these overlaps varied systematically across games (see Appendix Table A2). In 2012, we took this experimental design to small entrepreneurs in Ghana. We expected that, due to the nature of their occupation, these entrepreneurs would be more adept at perspective taking and thus at strategic reasoning. We also included a teamwork treatment, which we expected would further improve strategic reasoning via interactions among team members.[3] These expectation were not fulfilled: in both treatments, all but a handful of guesses fall in close proximity to one of our seven strategies of interest; the rest were not classifiable in any of the seven strategies.[4] From this experience we concluded that the design matrix was too complex for participants who had little education beyond secondary school and therefore were unlikely to have received any formal training in logic or strategic reasoning.

Learning from this experience, in this paper we revisit strategic reasoning with two major changes: a parameter matrix that is simpler than that used in Ghana; and a subject population of university students that is much more likely to have been exposed to abstract strategic reasoning and is therefore more comparable to that of earlier studies. The full set of parameters for the current experiment is provided in Appendix Table A3. We also introduce new treatments that are described in the next subsection.

2.1 Randomized Treatments

Subjects played 22 games under four treatment conditions, which were varied *between tasks within subjects*.

Control treatment (C) In 6 out of the 22 tasks, we revealed no information about the opponent and subjects played against an entirely anonymous university student. Four out of these control tasks were played at the beginning of the series of 22 tasks (i.e., tasks 1-4), and two were played at the end of the series (i.e., tasks 21-22).

In the remaining 16 tasks, we either revealed factual information about the

[3]Following an in-person group instruction session that lasted two hours, the game was played by the same participants over the phone via SMS messages over a period of 16 days, i.e., one game per day. By giving more time to subjects to consider their guesses and to learn from their mistakes, it was believed that this design would further facilitate strategic reasoning.

[4]Other researchers have also found a large fraction of guesses that are not classifiable: this is true of the original article, where around 51% of the guesses in their baseline experiment are not classifiable; and in Fragiadakis et al. (2016), the authors find 30% of non-classifiable subjects.

opponent (Info Treatment), showed a video of the opponent introducing him/herself (Video Treatment), or both (Combined Treatment).

Factual information treatment (T1) Our first treatment reveals the name of the opponent and some factual information about him/her. We focus on three traits: gender (male/female), field of study (STEM/non-STEM subject), and Grade Point Average (high grade/low grade).[5] Combining these traits produced eight *opponent profiles*, which match the characteristics of *actual* players in the opponent sessions, as described below.

Video treatment (T2) Our second treatment shows a video of the opponent introducing him/herself in less than one minute and sharing some fun facts about him/herself, which are easily and broadly relatable but carry no specific signals about their ability. Examples include their favorite dish or favorite activity.[6] The objective is to trigger a reaction based on emotive and affective empathy. Crucially, the opponents in the videos were selected to have the same characteristics as the 8 opponents whose information was shared in T1 (male/female, stem/non-stem, high-grade/low-grade). As in T1, therefore, we had eight different videos corresponding to the eight profiles.

Combined treatment (T3) Our third treatment combines T1 and T2 by providing both factual information about the opponent and showing the video. We used the same opponents as in the video treatment and, in addition to showing their videos, we provided factual information about their traits (gender, field of study, GPA).

Apart from the control treatment, subjects were matched with a different opponent for each task. This avoids any repeated game considerations. The combination of 8 profiles and two treatment arms per session de facto results in 16 treatments per subject. Each treatment was randomly assigned to one of the 16 treated tasks, and the order of these tasks differed between subjects. Conversely, the 6 control tasks were performed by

[5]A high grade was a First or an Upper Second attained in the previous academic year. A low grade was a Lower Second or lower.

[6]Having several opponents of both genders and backgrounds ensured sufficient diversity in the fun facts that were provided. This ensures that the average impact of the video documented below cannot be driven by any specific type of information shared in the videos.

all subjects in the same order, four at the beginning of the series, and two at the end of the series. The treatments were randomized across tasks within subjects as follows. Subjects in Sessions 1 to 7 received T1 and T3. This means that in one-half of the 16 treated tasks they saw opponents' profiles that included factual information, in the other half of the tasks they saw the videos + information. Subjects in Sessions 8 to 10 received T1 and T2. This means that in one-half of the tasks they saw opponents' profiles that included factual information, in the other half they only saw videos. For practical reasons and due to issues of statistical power, it was not feasible to randomize all three treatments within the same subject.

2.2 Implementation and Descriptive Statistics

The experiment was conducted over 10 sessions with 20 participants each. Subjects in a session did not play against other subjects in that session. This is because, to avoid deceiving participants, we needed to have obtained videos of actual opponents before any given session. Since asking subjects to produce videos could potentially have affected their behavior in the experiment (e.g., by triggering perspective taking), we instead ran two separate sessions at the beginning of the experiment to generate opponents' play, and we subsequently asked these subjects to produce videos. In these two initial sessions, participants were shown no information about their opponent, as in the control condition. This ensures that opponents are not given an advantage over the main participants in terms of strategic reasoning or perspective taking.

We then matched participants in the 10 experimental sessions with opponents from these two initial sessions – which are not themselves used in the analysis presented here. In other words, players in the two separate sessions are used as counterparts to the players in the main 10 sessions. This allows us to avoid deception: the main participants were simply told that they were playing the game against students from their university, which they were.

The experiment was conducted on tablets. Each session started with an explanation by an enumerator to the entire group of participants, after which each player completed the experiment individually. The initial explanation included standard examples to maximize understanding. After the 22 guesses, subjects completed a short survey. The full experimental instructions and some sample screenshots from the survey are included in Appendix B and C.

We recruited participants from various undergraduate (second year and above) and graduate degrees at the University of Dar es Salaam. Recruitment was primarily conducted through invitations sent to student representatives. Participating students came from a broad range of academic disciplines: Engineering (31), Law (13), Economics and Statistics (35), Other Social Sciences (29), Humanities (28), Natural Sciences (30), Agricultural and Food Sciences (14), Business (11), Kiswahili (6), and Development Studies (3). A total of 200 students from different disciplines participated in 10 sessions with 20 participants in each session. The sessions lasted approximately 2 hours and the average payoff per respondent was approximately TZS 75,000 (27.8 USD), plus a show-up payment of TZS 10,000 (3.7 USD).

In addition, we recruited eight students as *opponents* (4 males and 4 females), who played the game in a separate session. To fit the opponent descriptions provided to the players in the main sessions, these eight students were enrolled at the University of Dar es Salaam in the Bachelor of Education with either a ”science” or an ”arts and humanities” focus; they had either a high or low GPA.[7] These subjects were provided no information about their opponent, as in the control treatment (C).

3 Results

In this section, we report the results of the experiment. First, we document the level of strategic reasoning corresponding to each choice made by the subjects. Second, we analyze the relationship between the subjects' level of strategic reasoning and their beliefs

[7]Out of the 8 opponents, this gave us one male and one female enrolled in the Bachelor of Education (Science) with a first-class GPA in the previous year; one male and one female enrolled in the Bachelor of Education (Science) with a lower second class GPA in the previous year; one male and one female enrolled in the Bachelor of Education (Arts and Humanities) with a first-class GPA in the previous year; one male and one female enrolled in the Bachelor of Education (Arts and Humanities) with a lower second class GPA in the previous year.

about the opponent's guess, and thus the opponent's level of strategic reasoning. This relationship is central to identifying perspective taking. Third, we analyze the impacts of the various treatments on subjects' expectations of the opponent's action and on their own level of strategic reasoning.

The majority of guesses are consistent with a known level of strategic reasoning Table 1 categorizes participants' guesses based on the level of strategic reasoning that they imply, as Costa-Gomes and Crawford (2006) and Fragiadakis et al. (2016). More precisely, for each parameter vector in the experiment, we compute the guess that corresponds to each of our seven levels of strategic reasoning. For instance, a guess is level-1 if it is equal to the median of the opponent's allowed range of guesses, times the subject's assigned multiplier. It is level-2 if it is a best response to this level-1 guess, and level-3 if it is a best response to a level-2 guess. First, second, and third iterated dominance are similarly defined. The Nash equilibrium is obtained by iterating on level-k guesses until convergence is obtained. The full set of parameters is reported in Appendix Table A3). To recall, each guess is assigned to the closest benchmark – unless it is more than 10 units away, in which case it is assigned to the 'unknown' category. If two or more benchmarks are closest, it is assigned to the lowest strategic level of the two.

The analysis reveals that the majority of our subjects' choices fall within one of our seven levels of strategic thinking, ranging from simple strategies like L1 to Nash equilibrium. The largest proportion of assignable guesses (34.5%) falls under the category of "L1 strategy". Under this strategy, a player is "one step ahead" of the most unsophisticated player (L0), who just picks randomly over the interval.[8] The "L2 strategy" represents 14.2% of guesses. In this strategy, the player is two steps ahead of the most unsophisticated player, and so on. The "Nash equilibrium strategy" itself accounts for 1.7% of guesses. The results align well with previously cited studies that found that the majority of choices for which a strategy can be identified fall within low strategic reasoning levels.

[8]Example. Over an interval between 0 and 100, an unsophisticated (L0) player who picks randomly has an average guess of 50. For a multiplier of 1.5, an L1 player in this game would choose 75.

Some 44.6% of guesses cannot be assigned to one of the seven levels of strategic thinking we considered, a proportion that is similar to what previous studies have found (e.g., Fragiadakis et al., 2016). Of those, 10.2% indicate either a poor understanding of the game or a lack of attention. These are situations in which subject i's guess G_i is either above $\mu_i U_j$, that is, above the opponent's highest possible guess times i's multiplier, or below $\mu_i L_j$, that is, below the opponent's lowest possible guess times i's multiplier. Such guesses can never be a best response to any feasible play by opponent j. We call them 'confused' for short. The rest (34.4%) are within meaningful bounds but are not a best response to any belief about opponent j that could arise from perspective taking – i.e., they are not even a best response to random play by the opponent. It does not mean that those guesses are not rationalizable – e.g., subject i may believe that j will make a specific arbitrary guess G_j and pick a best response $G_i = \mu_i G_j$ to that. But that belief G_j cannot be obtained through strategic reasoning based on perspective taking.

These findings underscore the heterogeneous nature of decision-making in strategic settings, emphasizing the need for further exploration into the factors influencing participants' choices and the potential impact on overall game outcomes.

Table 1: Categorization of Guesses by Implied Degree of strategic reasoning

Level of strategic reasoning	N	Pct.	Cum. pct.
L1 strategy	1520	34.5	34.5
L2 strategy	624	14.2	48.7
L3 strategy	97	2.2	50.9
D1 first iterated dominance	82	1.9	52.8
D2 second iterated dominance	0	0	52.8
D3 third iterated dominance	40	.9	53.7
Nash equilibrium strategy	76	1.7	55.4
Unknown (includes L0)	1512	34.4	89.8
Confused	449	10.2	100
Total	4400		

Notes. This table shows the level of strategic reasoning (k-level) implied by each guess. The experiment had 200 participants. Each participant made 22 guesses. This produced 4400 guesses in total. When the guess cannot be reconciled with (i.e., it is too far from) a known level of strategic reasoning, it is categorized as "Unknown" or "Confused".

Players' level of strategic reasoning is strongly and positively correlated with the opponent's level of strategic reasoning implied by their beliefs Table 2 provides a detailed examination of the correlation between players' level of strategic reasoning and their expectation of their opponent's level. We estimate an Ordinary Least Squares (OLS) regression model in which each observation is a subject's guess in one task and the dependent variable is the level of strategic reasoning implied by that guess. Levels vary from 1 to 7 as in Table 1 (with 1 denoting L1 and 7 representing Nash equilibrium). The independent variable is constructed from the subject's reported belief about their opponent and is the expected level of strategic reasoning of the opponent that is implied by that belief; it is also categorized from 1 to 7. Beliefs about an opponent's guess are handled in the same way as subjects' guesses, that is, a belief is classified as falling in one of the seven categories if it is within 10 units of the corresponding benchmark. Beliefs that are out of bounds or cannot be rationalized by one of our seven levels of strategic reasoning are excluded from the analysis. If guesses are within 10 units of two or more benchmarks, they are assigned the strategy whose benchmark is closest; if several benchmarks are closest, they are assigned to the lowest strategy.

Table 2: Correlation between Levels of Own and Expected Strategic Reasoning

	OLS	Player FE
	(1)	(2)
Expected opponent's level of strategic reasoning	.536	.502
	(.030)***	(.030)***
Const.	.833	.891
	(.059)***	(.058)***
Player FE	No	Yes
N	1404	1404

NOTES. This table shows the results of an OLS regression of own level of strategic reasoning (a categorical variable taking values from 1 to 7) on the expected level of strategic reasoning of the opponent (a categorical variable taking the same values 1 to 7). The unit of analysis is an individual guess (each subject makes 22 guesses, one for each of their 22 tasks). The regression excludes observations in which the subject's own guess or the expected guess of the opponent is classified as "unknown" or "confused". *p < 0.10; **p < 0.05; ***p < 0.01.

Level-k thinking would imply an intercept equal to one: if the level of strategic reasoning ascribed to the opponent is 0, the subject's best response is to choose the level-1 strategy. Furthermore, if the level of strategic reasoning ascribed to the opponent increases by one unit, the best response of a level-k subject should increase by one unit as well. These predictions are put to the test in Table 2, with two specifications: (1) OLS and (2) Player Fixed Effects (FE). We first note that, in both regressions, the intercept is close to 1 – and not statistically different from 1 at the 5% level in the Player FE regression. Secondly, we find a large and significant coefficient on the opponent's expected level of strategic reasoning, but it is also statistically lower than 1. In the OLS regression (Column 1), the coefficient on the expected opponent's level of strategic reasoning is large (0.536) and statistically significant at the 1% level, indicating a strong positive correlation. This implies that for each unit increase in the expected opponent's level of strategic reasoning, the player's own level increases by 0.536 units (on a scale from 1 to 7). In the FE specification (Column 2), this coefficient only falls slightly (0.502) and remains strongly statistically significant from 0.

These findings indicate that subjects select a higher level of strategic thinking for themselves when they implicitly assign a higher level of strategic thinking to their opponent. Furthermore, the results indicate that subjects' own level of strategic reasoning tends to be higher than that ascribed to their opponent – at least at the predominantly low levels of strategic reasoning reported in Table 1. For instance, subjects who believe their opponent to be level-1 are, on average, level 1.369 (OLS) or 1.393 (Player FE): not quite 2, but significantly higher than 1. Taken together, these findings are strongly suggestive of perspective taking: subjects tend to select their own strategy as a best response to what they believe their opponent will do.

On average, our treatments increase the subjects' expectation of their opponent's level of strategic reasoning Table 3 reports the impacts of providing *any* of our three treatments (factual information, video, or both) on expectations of the opponent's level of strategic reasoning. As before, the analysis is conducted at the level of individual tasks. In each task, subjects were asked to state what guess they believe the opponent will make. As in the previous section, this belief allows us to infer the level of strategic reasoning ascribed to the opponent by the subject for that task. We now use this as the dependent variable in the analysis.

Table 3: Joint treatment effect on the opponent's anticipated level of strategic reasoning

Dep. Var.: Anticipated level of strategic reasoning of opponent	OLS (1)	Player F.E. (2)	Player F.E. (3)
Any treatment	.455 (.044)***	.450 (.045)***	.388 (.054)***
Task order			.012 (.004)***
Cons.	1.295 (.039)***	1.299 (.035)***	1.208 (.042)***
Player F.E.	No	Yes	Yes
N	2132	2132	2132

NOTES. This table shows the average impact of our three treatments on the anticipated level of strategic reasoning of the opponent, relative to control tasks where no factual information or video of the opponent was provided. The unit of analysis is an individual guess (each subject makes 22 guesses, one for each of the 22 tasks). The dependent variable is a categorical variable taking values from 1 to 7 that correspond to the anticipated levels of strategic reasoning of the opponent, where 1 is L1 and 7 is Nash equilibrium. Column (2) includes player fixed effects. Column (3) add a variable taking values from 1 to 22 for the order in which the task was played. This controls for possible learning effect as subjects progress through the experimental session. The regression excludes guesses for which the expected opponent's level of strategic reasoning is classified as "unknown" or "confused". Standard errors are clustered at the individual player level. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

In the OLS regression (Table 3, Column 1), the coefficient on "Any treatment" is 0.455, indicating that the treatments on average increase the expected strategic reasoning level of the opponent by 0.455 units, an effect that is statistically significant at the 1% level and large in magnitude: 0.455/1.295 = a 35% increase relative to control subjects. This result is consistent with the hypothesis that, in the absence of any factual or visual information, subjects tend to ascribe lower sophistication to their opponent. This is due, we hypothesize, to the fact that receiving factual or visual insights of who they are playing against induces subjects to reflect on their opponent's choices and motives more carefully (i.e., 'they step into their shoes'). As a result, they ascribe greater sophistication to the opponent than they would in the absence of treatment.

Adding Player fixed effects (Column 2 of Table 3) does not change the coefficient of interest (0.450) or its statistical significance. The last specification (Column 3) introduces a variable for the order, from 1 to 22, in which the task was played. Its purpose is to control for learning effects over the course of the experiment. Adding this variable lowers the coefficient on the "any treatment" variable to 0.388, but its statistical significance remains and the magnitude of the treatment effect is still large: $0.388/1.208 = 32\%$ increase relative to controls. We also find that the order in which the task was completed has a positive and significant effect on the dependent variable, indicating that, as the experiment progresses, subjects raise their beliefs about the level of strategic reasoning of their opponent. This suggests that experience gathered during the game increases perspective taking, but not so much that it eliminates the direct effect of treatment. In fact, the effect of treatment remains dominant even at the end of the sessions: 22 times $0.012 = 0.264$, which is less than 0.388.

The effect of factual information on perspective taking is magnified when combined with the video We now estimate the average effect of each treatments separately. As in Table 3, the dependent variable is the anticipated level of strategic reasoning of the opponent.

Table 4: Treatment effects on the opponent's anticipated level of strategic reasoning

Dep. Var.: Anticipated level of strategic reasoning of opponent	T1-T3 (1)	T1-T3 (2)	T1-T3 (3)	T1-T2 (4)	T1-T2 (5)	T1-T2 (6)
T1 - Factual information	.426 (.053)***	.420 (.057)***	.359 (.066)***	.371 (.087)***	.386 (.088)***	.322 (.107)***
T2 - Video				.011 (.081)	-.025 (.090)	-.027 (.089)
T3 - Factual information + Video	.553 (.070)***	.548 (.069)***	.489 (.075)***			
Task order			.011 (.005)**			.014 (.007)*
Cons.	1.283 (.044)***	1.287 (.040)***	1.205 (.053)***	1.324 (.080)***	1.326 (.070)***	1.213 (.065)***
Player F.E.	No	Yes	Yes	No	Yes	Yes
N	1489	1489	1489	643	643	643

NOTES. This table shows the impact of the different treatments on the anticipated level of strategic reasoning of the opponent, as inferred from the subjects' belief about their opponent's most likely guess. The unit of analysis is an individual guess (each subject makes 22 guesses, one for each of the 22 tasks). Column (2) and (4) include player fixed effects. The regression excludes guesses for which the expected opponent's level of strategic reasoning is classified as "unknown" or "confused". In columns (1) and (2) we use sessions 1 - 7 of the experiment. In columns (3) and (4) we use sessions 8 - 10. Standard errors are clustered at the individual player level. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table 4 shows that in all our specifications the factual information treatment (T1) has a substantial and statistically significant effect on the expected level of strategic reasoning of the opponent. When participants receive factual information about their opponent, there is an average increase in the *expected* strategic reasoning level of the opponent of 0.426 units – an increase of 33% relative to controls. This result remains essentially unchanged when we include player fixed effects but, as in Table 3, its magnitude is reduced somewhat when we include task order as an additional regressor – although it remains significant. including the task order reduces the magnitude of the treatment effect somewhat. These findings are consistent with the hypothesis that factual information enhances perspective taking, probably due to what Batson (2009) calls psychological empathy.

Second, the video treatment (T2) on its own has no effect on the expected strategic reasoning level of the opponent (Column 4). Including player fixed effects does not change this conclusion (Column 5), and neither does adding task order (Column 6). Since the video was deliberately designed *not* to convey information on the opponent's strategic skill but to trigger an emotive or affective response, this finding suggests that emotive or affective empathy have, on their own, no effect on perspective taking.

Thirdly, we find that the video treatment enhances the impact of the information treatment when combined with it (Columns 1 to 3): treatment (T3) has a coefficient of .553, which is more than 25% larger than the information treatment alone (.426). This difference is statistically significant at the 10% level (p-value = .07) and is large in magnitude (43% of the control mean). Similar findings are obtained when we include player FE (Column 2) and task order (Column 3) – except for the small fall in magnitude with the latter. These findings suggest that perspective taking responds more to factual information about the opponent's strategic skill when it is amplified by an emotive or affective response to the video. Taken together, the evidence suggests that perspective taking can be magnified by combining psychological empathy – triggered by factual information – with emotive and affective cues.

On average, our treatments increase the subjects' level of strategic reasoning Having discussed how our treatments impact the subjects' expectation of strategic reasoning by their opponent, we now discuss their joint impact on players' own level of strategic reasoning.

Table 5: Joint treatment effect on own strategic reasoning

Dep. Var.: Own level of strategic reasoning	OLS (1)	Player F.E. (2)	Player F.E. (3)
Any treatment	.312 (.056)***	.298 (.059)***	.242 (.067)***
Task order			.012 (.004)***
Cons.	1.467 (.059)***	1.478 (.045)***	1.389 (.050)***
Player F.E.	No	Yes	Yes
N	2439	2439	2439

NOTES. This table shows the average impact of our three treatments on the subjects' level of strategic reasoning, relative to control tasks where no factual information or video of the opponent was provided. The unit of analysis is an individual guess (each subject makes 22 guesses, one for each of the 22 tasks). The dependent variable is a categorical variable taking values from 1 to 7 that correspond to the levels of strategic reasoning of the subject, where 1 is L1 and 7 is Nash equilibrium. Column (2) includes player fixed effects. Column (3) add a variable taking values from 1 to 22 for the order in which the task was played. This controls for possible learning effect as subjects progress through the experimental session. The regression excludes guesses for which the subject's level of strategic reasoning is classified as "unknown" or "confused". Standard errors are clustered at the individual player level. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table 5 mirrors Table 3, except that it now estimates the average effect of receiving any of the three treatments on the level of the subject's own strategic reasoning. As before, the table presents regression results with three different specifications: an OLS regression, a model with player fixed effects, and a model that includes both player fixed effects and a control for the task order. The dependent variable is inferred from the subject's guess, as described before.

Consistent with previous analysis, the results indicate that, on average, the treatments lead to an increase in the level of the subject's own strategic reasoning. This can be seen as a rational response to the increase in expected level of strategic reasoning of the opponent that was shown in Table 5. As in that Table, we observe a reduction in the coefficient when we include task order to control for learning effects, but the treatment effect remains statistically significant at the 1% level. The relative magnitude of the effect is not as large as in Table 3 – between 17 and 21%, depending on the regression model – but it remains non-negligible. If we compare the intercepts in Table 5 to those in

Table 3, we also note that, as predicted by level-k theory, subjects' own level of strategic reasoning without treatment is higher (by 13 to 15%) than what they attribute to their opponent – although the magnitude of the difference is much less than 1.

Table 6: Treatment effects on the subjects' level of strategic reasoning

Dep. Var.: Own level of strategic reasoning	T1-T3 (1)	T1-T3 (2)	T1-T3 (3)	T1-T2 (4)	T1-T2 (5)	T1-T2 (6)
T1 - Factual information	.322 (.073)***	.306 (.076)***	.227 (.085)***	.207 (.093)**	.189 (.093)**	.174 (.105)*
T2 - Video				.034 (.086)	.047 (.088)	.045 (.088)
T3 - Factual information + Video	.394 (.093)***	.373 (.100)***	.292 (.110)***			
Task order			.015 (.006)**			.004 (.006)
Cons.	1.483 (.068)***	1.498 (.058)***	1.387 (.066)***	1.432 (.115)***	1.441 (.070)***	1.406 (.064)***
Player F.E.	No	Yes	Yes	No	Yes	Yes
N	1623	1623	1623	816	816	816

Notes. This table shows the impact of the different treatments on the level of strategic reasoning of the subjects, as inferred from the subjects' guesses. The unit of analysis is an individual guess (each subject makes 22 guesses, one for each of the 22 tasks). Columns (2) and (4) include player fixed effects. The regression excludes guesses for which the level of strategic reasoning is classified as "unknown" or "confused". In columns (1) and (2) we use sessions 1 - 7 of the experiment. In columns (3) and (4) we use sessions 8 - 10. Standard errors are clustered at the individual player level. *p < 0.10; **p < 0.05; ***p < 0.01.

We then estimate the individual effect of the three treatments T1, T2, and T3. Results are shown in Table 6, which is similar to Table 4 except for the different dependent variable. Here too the results are consistent with the findings in Table 4. The information treatment (T1) increases the level of the subject's own strategic reasoning while the video treatment (T2) has no impact on its own. The combined effect of information and video is again larger than the effect of the information treatment in isolation, in line with the idea that the video enhances the impact of factual information. The coefficient on the T3 dummy is not, however, significantly different from the coefficient on T1 in this case. The inclusion of player fixed effects does not change the conclusions. The magnitude of the effects remains large, although they are slightly smaller than those reported in 4, partly because the control mean (represented by the intercept) is higher: 22% and 14% for T1 in Columns 1 and 4, respectively; and 27% for T3 in Column 1.

Taken together, these findings indicate that providing factual information about the opponent increases subjects' level of strategic reasoning, and that this effect operates by raising subjects' beliefs about the level of strategic reasoning of their opponent – a body of evidence consistent with a causal mechanism operating at least partly through perspective taking. Further evidence for this interpretation comes from the finding that adding a fun video of the opponent to the factual information magnifies the effect of this information on both expectations and own strategic thinking, suggesting that perspective taking is enhanced by the affective or emotive response to the visual material.

4 Robustness analysis

In this section, we subject our results to a battery of robustness checks. We first re-estimate our main regressions of interest on the full dataset, not just the observations assigned to an identifiable level of strategic reasoning (i.e., from 1 to 7). Instead, we give a value of 0 (for level-0) to all guesses classified as 'unknown' in Table 1. Table 7 mirrors Table 4 with this expanded dataset that includes 50% more observations in sessions 1-7 (Columns 1-3) and 57% in sessions 8-10 (Columns 4-6).

The results are not qualitatively different from those reported in Table 4, either in level of statistical significance, or in magnitude. Estimated coefficients are slightly smaller but the biggest difference is in the intercepts, which are much lower (e.g., 0.557 compared to 1.283 in Column 1 of 4). This is hardly surprising since, in that Table, we omit all observations for which the level of strategic reasoning is 0. But it means that the relative magnitude of the treatment effects is now much larger. The effect of the factual information (T1) now represents a 69% increase relative to controls in Column 1 and 76% in Column 4. The relative magnitude of the effect of the combined treatment (T3) is even larger – 78% in Column 1 – while the effect of the video on its own (T2) still has no effect on the anticipated level of statistical reasoning of the opponent. We also note that, in these regressions, task order has no effect, either in statistical significance

Table 7: Treatment effects on the opponent's anticipated level of strategic reasoning - Including "unknown" strategies

Dep. Var.: Anticipated level of	T1-T3	T1-T3	T1-T3	T1-T2	T1-T2	T1-T2
strategic reasoning of opponent	(1)	(2)	(3)	(4)	(5)	(6)
T1 - Factual information	.382	.373	.366	.443	.422	.404
	(.035)***	(.037)***	(.041)***	(.058)***	(.064)***	(.072)***
T2 - Video				-.080	-.061	-.063
				(.066)	(.068)	(.068)
T3 - Factual information + Video	.434	.427	.419			
	(.043)***	(.044)***	(.050)***			
Task order			.002			.005
			(.003)			(.004)
Cons.	.557	.562	.547	.585	.593	.555
	(.026)***	(.023)***	(.027)***	(.039)***	(.040)***	(.041)***
Player F.E.	No	Yes	Yes	No	Yes	Yes
N	2237	2237	2237	1009	1009	1009

NOTES. This table shows the impact of the different treatments on *the expected strategic reasoning level of the opponent* (k-level), as inferred from the subjects' belief about their opponent's most likely guess, relative to control tasks where no information about the opponent was provided. We include guesses implying an "unknown" level of strategic reasoning. The unit of analysis is the individual guess (each subject makes 22 guesses in 22 tasks). The dependent variable (opponent's strategic reasoning) is a categorical variable taking values 0 to 7, which correspond to 8 levels of strategic reasoning, where 0 is Unknown, 1 is L1, and 7 is Nash equilibrium. Column (2) and (4) include player fixed effects. The regression excludes guesses for which the expected opponent's strategy is classified as "confused". In columns (1) and (2) we use sessions 1 - 7 of the experiment. In columns (3) and (4) we use sessions 8 - 10. Standard errors are clustered at the individual player level. *p < 0.10; **p < 0.05; ***p < 0.01.

or in magnitude. These findings indicate that, if anything, our earlier reported results are conservative.

Next, we apply the same approach to Table 5, which increases the number of observations by 63% in the first three columns and by 47% in the last three. The results are presented in Table 8. Treatment effects are qualitatively similar but much larger in magnitude: the factual information treatment increases the subject's level of strategic reasoning by 68% relative to controls in Column 1, and by 67% in Column 4 – compared to 22% and 14% when we omit all 'unknown' (level-0) guesses. For the combined treatment T3, the magnitude of the effect is 77% higher than controls – compared to 27% when we omit 'unknowns'. Again, this confirms that our earlier results were, if anything, conservative.

Another possible concern is that the iterated dominance concept is too complex

Table 8: Treatment effects on the subjects' own level of strategic reasoning - Including "unknown" strategies

Dep. Var.: Own level of strategic reasoning	T1-T3 (1)	T1-T3 (2)	T1-T3 (3)	T1-T2 (4)	T1-T2 (5)	T1-T2 (6)
T1 - Factual information	.395 (.035)***	.387 (.036)***	.405 (.036)***	.431 (.051)***	.424 (.052)***	.417 (.055)***
T2 - Video				-.062 (.062)	-.066 (.064)	-.066 (.064)
T3 - Factual information + Video	.449 (.041)***	.438 (.042)***	.457 (.042)***			
Task order			-.005 (.003)*			.002 (.004)
Cons.	.583 (.024)***	.590 (.022)***	.634 (.034)***	.648 (.034)***	.654 (.028)***	.636 (.037)***
Player F.E.	No	Yes	Yes	No	Yes	Yes
N	2648	2648	2648	1203	1203	1203

NOTES. This table shows the impact of the different treatments on *own strategic reasoning* (k-level), relative to control tasks where no information about the opponent was provided. We include guesses implying an "unknown" level of strategic reasoning. The unit of analysis is the individual guess (each subject makes 22 guesses in 22 tasks). The dependent variable (own strategic reasoning) is a categorical variable taking values 0 to 7, which correspond to 8 levels of strategic reasoning, where 0 is Unknown, 1 is L1, and 7 is Nash equilibrium. Column (2) and (4) include player fixed effects. The regression excludes guesses for which the strategy is classified as "confused". In columns (1) and (2) we use sessions 1 - 7 of the experiment. In columns (3) and (4) we use sessions 8 - 10. Standard errors are clustered at the individual player level. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

for the subjects and that those few guesses that were assigned to those categories are, in fact, random guesses that should have been assigned to the 'unknown' category instead. To ascertain whether this drives our results, we re-estimate Tables 4 and 5 by removing categories D1, D2, and D3 from our list of recognized levels of strategic reasoning. We only keep L1, L2, L3, and Nash – which can be calculated mentally by iterating on level-k reasoning. The strategic reasoning variables now only take values from 1 (L1) to 4 (Nash).

The results are presented in Table 9 for the subjects' expected level of strategic reasoning of the opponent. Results are qualitatively similar to those in Table 3: T1 has a significant effect large in magnitude throughout, T3 has an effect 20 to 34% larger in magnitude than T1, depending on the regression, and T2, the video on its own, has no effect.

Turning to the subject's own level of strategic reasoning, the results, shown in

Table 9: Treatment effects on the opponent's anticipated level of strategic reasoning - Excluding D1-D3 strategies

Dep. Var.: Anticipated level of strategic reasoning of opponent	T1-T3 (1)	T1-T3 (2)	T1-T3 (3)	T1-T2 (4)	T1-T2 (5)	T1-T2 (6)
T1 - Factual information	.267 (.041)***	.258 (.045)***	.206 (.050)***	.313 (.059)***	.313 (.063)***	.274 (.068)***
T2 - Video				-.067 (.060)	-.066 (.065)	-.071 (.065)
T3 - Factual information + Video	.321 (.046)***	.328 (.047)***	.277 (.054)***			
Task order			.010 (.003)***			.009 (.005)*
Cons.	1.250 (.033)***	1.251 (.030)***	1.176 (.033)***	1.261 (.054)***	1.261 (.048)***	1.188 (.054)***
Player F.E.	No	Yes	Yes	No	Yes	Yes
N	1269	1269	1269	593	593	593

NOTES. This table shows the impact of the different treatments on *the expected strategic reasoning level of the opponent* (k-level), as inferred from the subjects' belief about their opponent's most likely guess, relative to control tasks where no information about the opponent was provided. Guesses that previously corresponded to D1-D3 strategies are now excluded unless they fall within a distance of 10 units from the benchmark of another strategy (L1, L2, L3, Nash). As before, if guesses fall within a distance of 10 units from the benchmarks of multiple strategies, they are assigned to the closest one. The unit of analysis is the individual guess (each subject makes 22 guesses in 22 tasks). The dependent variable (opponent's strategic reasoning) is a categorical variable taking values 1 to 4, which correspond to 4 levels of strategic reasoning, where 1 is L1, 2 is L2, 3 is L3, and 4 is Nash equilibrium. Column (2) and (4) include player fixed effects. The regression excludes guesses for which the expected opponent's strategy is classified as "unknown" or "confused". In columns (1) and (2) we use sessions 1 - 7 of the experiment. In columns (3) and (4) we use sessions 8 - 10. Standard errors are clustered at the individual player level. *p < 0.10; **p < 0.05; ***p < 0.01.

Table 10, are in the same vein: a large and consistently significant effect of T1 on strategic reasoning, a larger effect of T3, and no effect for T1. This robustness check therefore confirms that our results are not an artifact of having included strategic categories D1 to D3 that may be too complicated to have been considered by experimental subjects.

Before concluding, we revisit the issue of learning in the experiment, and the potential residual effect of treatment on perspective taking after the removal of any treatment. To recall, all subjects played six control games – four at the beginning of the session, and two at the end. In Tables 3 and 5, we found evidence of a task order effect in both expected strategic reasoning of the opponent and own strategic reasoning. We interpreted this evidence as suggesting that (some) subjects learned to rely more on perspective taking when making strategic. We now wish to test whether this learning

Table 10: Treatment effects on the subjects' own level of strategic reasoning - Excluding D1-D3 strategies

Dep. Var.: Own level of strategic reasoning	T1-T3 (1)	T1-T3 (2)	T1-T3 (3)	T1-T2 (4)	T1-T2 (5)	T1-T2 (6)
T1 - Factual information	.279 (.041)***	.274 (.045)***	.252 (.049)***	.179 (.048)***	.170 (.054)***	.166 (.059)***
T2 - Video				.019 (.058)	.025 (.060)	.025 (.060)
T3 - Factual information + Video	.343 (.048)***	.340 (.051)***	.318 (.055)***			
Task order			.004 (.003)			.001 (.004)
Cons.	1.257 (.032)***	1.259 (.030)***	1.231 (.036)***	1.275 (.054)***	1.279 (.038)***	1.269 (.045)***
Player F.E.	No	Yes	Yes	No	Yes	Yes
N	1552	1552	1552	787	787	787

NOTES. This table shows the impact of the different treatments on *own strategic reasoning* (k-level), relative to control tasks where no information about the opponent was provided. Guesses that previously corresponded to D1-D3 strategies are now excluded unless they fall within a distance of 10 units from the benchmark of another strategy (L1, L2, L3, Nash). As before, if guesses fall within a distance of 10 units from the benchmarks of multiple strategies, they are assigned the closest one. The unit of analysis is the individual guess (each subject makes 22 guesses in 22 tasks). The dependent variable (opponent's strategic reasoning) is a categorical variable taking values 1 to 4, which correspond to 4 levels of strategic reasoning, where 1 is L1, 2 is L2, 3 is L3, and 4 is Nash equilibrium. Column (2) and (4) include player fixed effects. The regression excludes guesses for which the strategy is classified as "unknown" or "confused". In columns (1) and (2) we use sessions 1 - 7 of the experiment. In columns (3) and (4) we use sessions 8 - 10. Standard errors are clustered at the individual player level. *p < 0.10; **p < 0.05; ***p < 0.01.

in perspective taking has a persistent effect that remains after all treatments have been removed. To do this, we compare levels of strategic reasoning between the first four tasks and the last two: if the treatments have to be present in order to encourage subjects to engage in perspective taking, we should observe no difference between the before and after control games.

The results of this test are shown in Table 11 for the expected level of strategic reasoning of the opponent, and in Table 12 for the subject's own level of strategic reasoning. We find a very strong effect on the expected level of strategic reasoning of the opponent (Table 11): the difference is statistically significant and large in magnitude – a 27-28% increase in control games played at the end relative to control games played at the beginning. We also find a positive estimated coefficient for own strategic reasoning in Table 12. But the effect is smaller (7%) and not statistically significant. From this, we conclude that we find some evidence of a persistent effect of learning from the treatments on perspective thinking after the treatments have been switched off. But we probably do not have a sufficient sample size to statistically identify an effect in the subject's own level of strategic reasoning.

Table 11: Opponent's anticipated level of strategic reasoning in control tasks played after vs. before treated tasks

Dep. Var.: Anticipated level of strategic reasoning of opponent	OLS (1)	Player F.E. (2)
After Treatment	.322	.310
	(.068)***	(.094)***
Cons.	1.163	1.166
	(.024)***	(.026)***
Player F.E.	No	Yes
N	462	462

NOTES. This table shows the impact of undergoing the full series of sixteen treated tasks on *the expected strategic reasoning level of the opponent* (k-level). We estimate this by confining the analysis to the six control tasks, and comparing the control tasks played after the series of sixteen treated tasks with the control tasks played before the treated tasks. The unit of analysis is the individual guess (each subject makes 22 guesses in 22 tasks). The dependent variable (opponent's strategic reasoning) is a categorical variable taking values 1 to 7, which correspond to 4 levels of strategic reasoning, where 1 is L1 and 7 is Nash equilibrium. Column (2) includes player fixed effects. The regression excludes guesses for which the expected opponent's strategy is classified as "unknown" or "confused". Standard errors are clustered at the individual player level. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table 12: Subjects' own level of strategic reasoning in control tasks played after vs. before treated tasks

Dep. Var.: Own level of strategic reasoning	OLS (1)	Player F.E. (2)
After Treatment	.090	.091
	(.068)	(.086)
Cons.	1.239	1.238
	(.026)***	(.023)***
Player F.E.	No	Yes
N	564	564

NOTES. This table shows the impact of undergoing the full series of sixteen treated tasks on *own strategic reasoning* (k-level). We estimate this by confining the analysis to the six control tasks, and comparing the control tasks played after the series of sixteen treated tasks with the control tasks played before the treated tasks. The unit of analysis is the individual guess (each subject makes 22 guesses in 22 tasks). The dependent variable (opponent's strategic reasoning) is a categorical variable taking values 1 to 7, which correspond to 4 levels of strategic reasoning, where 1 is L1 and 7 is Nash equilibrium. Column (2) includes player fixed effects. The regression excludes guesses for which the strategy is classified as "unknown" or "confused". Standard errors are clustered at the individual player level. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

5 Conclusions

Our study investigates the role of perspective taking on beliefs about an opponent's level of strategic reasoning and, in turn, on one's own strategic reasoning. The research is conducted using a series of guessing games in which we provide subjects with factual information or visual cues about their opponent.

Our findings reveal that providing factual information about opponents increases the level of strategic reasoning attributed to the opponent as well as the subject's own. This is consistent with the idea that psychological empathy can trigger perspective taking (e.g., Batson, 2009). We also find no effect on strategic reasoning from the treatment that provided subjects with a fun video that contained visual cues about the opponent and information about their hobbies and interests, but was designed not to convey relevant information about their strategic skills. This is consistent with the idea that more affective or emotive dimensions of empathy, which should have been activated by the video, are insufficient to trigger perspective taking in the context of a strategic interaction between two agents. However, we also find that, when it is combined with the factual information treatment, the video does increase the level of strategic reasoning ascribed to the opponent and manifested by the subject. This suggests that more affective or emotive dimensions of empathy can improve perspective taking in strategic situations when it is combined with information about the strategic skills of the opponent.

Our experiment was not designed to capture *how* affective or emotive dimensions of empathy combine with information to improve strategic perspective taking. This could arise because they raise attention to the personality of the opponent, and induce more effort in processing the factual information. Alternatively, it is also possible that triggering an emotive and affective response in subjects makes it easier for them to put themselves 'in the shoes' of a more strategically skilled opponent.

In summary, our research advances the understanding of how perspective taking can influence decision-making in strategic settings either through psychological empathy or via an emotive and affective response. We have found that psychological empathy is central, but also that it can be enhanced by visual cues. These insights have implications not only for game theory and behavioral economics but also for discussions surrounding the potential of perspective taking to mitigate biases and contribute to a more informed, less polarized public dialogue.

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Appendix

A Task Parameters

Table A1: Original Costa-Gomez and Crawford (2006) Task Parameters

Task	L_i	U_i	μ_i	L_j	U_j	μ_j
1	300	900	0.7	100	900	1.3
2	100	900	1.3	300	900	0.7
3	100	900	0.5	100	500	1.5
4	100	500	1.5	100	900	0.5
5	100	500	0.7	100	500	1.5
6	100	500	1.5	100	500	0.7
7	300	500	0.7	100	900	1.5
8	100	900	1.5	300	500	0.7
9	100	500	0.7	100	900	0.5
10	100	900	0.5	100	500	0.7
11	300	900	1.3	300	900	1.3
12	300	900	1.3	300	900	1.3
13	300	500	1.5	300	900	1.3
14	300	900	1.3	300	500	1.5
15	100	900	0.5	300	500	0.7
16	300	500	0.7	100	900	0.5

Table A2: Ghana Task Parameters

Task	L_i	U_i	μ_i	L_j	U_j	μ_j
1	200	800	0.7	100	900	1.2
2	100	500	1.1	100	900	0.6
3	300	900	0.8	100	900	1.3
4	100	1000	1.3	300	800	0.7
5	100	900	0.5	100	600	1.5
6	100	500	1.3	100	900	0.7
7	100	500	0.5	100	500	1.5
8	200	600	1.4	200	700	0.7
9	100	700	0.7	100	900	1.2
10	200	900	1.4	300	900	0.7
11	100	900	0.5	100	500	1.5
12	100	500	1.4	100	900	0.6
13	200	600	0.7	100	600	1.3
14	100	500	1.5	100	500	0.7
15	200	800	1.5	200	700	0.7
16	200	600	0.6	100	700	1.5

Table A3: Tanzania Task Parameters

Task	L_i	U_i	μ_i	L_j	U_j	μ_j
1	0	100	1	0	100	1
2	0	100	1	0	100	2
3	0	100	2	0	100	1
4	0	100	1	0	100	0.5
5	0	100	1	0	100	1
6	0	100	1	0	100	2
7	0	100	2	0	100	1
8	0	100	1	0	100	0.5
9	0	100	0.5	0	100	1
10	0	100	1	0	200	1
11	40	100	1	0	100	1
12	40	200	0.5	0	100	1
13	0	100	1	40	200	1
14	0	100	1	40	200	0.5
15	0	100	1	40	100	1
16	0	200	1	0	100	1
17	0	200	0.5	0	100	1
18	40	200	1	0	100	1
19	0	100	1	0	200	0.5
20	0	100	0.5	100	400	2
21	0	200	2	0	200	1
22	0	200	1	0	200	0.5

B Game Instructions

Experimental Study of Strategic Interaction using Guessing Games

INSTRUCTIONS TO BE READ TO PARTICIPANTS

Welcome!

You are about to participate in an experiment to test how you make decisions.

You will shortly receive some simple instructions and complete the experiment over the course of the next 2 hours.

For participating in today's session, you will receive **10,000 TSh**.

In addition, you may earn a considerable additional amount, depending on the decisions you make.

On average, participants in this game win about **65,000 TSh on top of the participation fee**.

Your earnings will be determined by your decisions and by the decisions of other participants. We now explain in detail how the game works and how your winnings are exactly determined. We kindly ask you to pay attention to the explanation and if you have any questions, please raise your hand.

At the end of the session, you will be asked to sit an understanding test to evaluate if you have understood the rules of the game. It is important, therefore, that you pay attention and raise any questions you might have during this training session.

INSTRUCTIONS

The experiment has 22 rounds.

In each round, you will be matched randomly with another player (a new one in each round), who will be your opponent in that round.

Your opponent does not know who you are. They only know that they are playing against a student from the University of Dar es Salaam.

In each round, you and your opponent separately and independently make decisions called GUESSES. Together, your GUESS and your opponent's GUESS determine the number of POINTS that you earn in a round.

Earning more points increases your money payment at the end of the experiment, as explained below.

NOTE: Neither your guess nor your opponent's guess in a round affects how you and your opponents are matched or the games you face in the rest of the experiment.

To make a good guess, you must understand how your guess and your opponent's guess determines the number of points that you and they earn in every decision situation. Here is how.

In each decision situation, each player has a **MULTIPLIER**, a **LOWER LIMIT** and an **UPPER LIMIT**. These multipliers and limits are typically different for you and your opponent, and they change from round to round. In all other respects, the games are identical in all 22 rounds.

In each round, each player is asked to guess a number between their lower limit and upper limit. The opponent is asked to also guess a number.

1

If you guess outside your limit, your guess is automatically adjusted down to the upper limit (if it is above it), or up to the lower limit (if it is below it).

The aim of the game is to guess a number that is as close as possible to your opponent's guess *times* your multiplier.

The closer your guess is to your opponent's guess times your multiplier, the higher the number of points you earn in each game.

EXAMPLE:

A: YOUR LOWER LIMIT = 100 and YOUR UPPER LIMIT = 900
B: YOUR MULTIPLIER = 2
C: YOUR OPPONENT'S LOWER LIMIT = 100 and YOUR OPPONENT'S UPPER LIMIT = 600
D: YOUR OPPONENT MULTIPLIER = 2

YOU:

LOWER LIMIT	**UPPER LIMIT**
100	**900**

MULTIPLIER = 2

YOUR OPPONENT

LOWER LIMIT	**UPPER LIMIT**
100	**600**

MULTIPLIER = 2

You receive the most points if you can guess a number that is equal to your opponent's guess times 2. In order to win the game, you must try to understand what your opponent is going to guess and multiply it by your multiplier.

The further away you are from the perfect guess, the fewer points you make.

NOTE: Your guesses should not have decimal places.

LET'S TRY:

[The experimenter plays the mock game above between himself and another collaborator. They both make their guesses and at the end, the payoffs are worked out as follows – referring to the graph below].

[Player A picks 300; Player B picks 200]

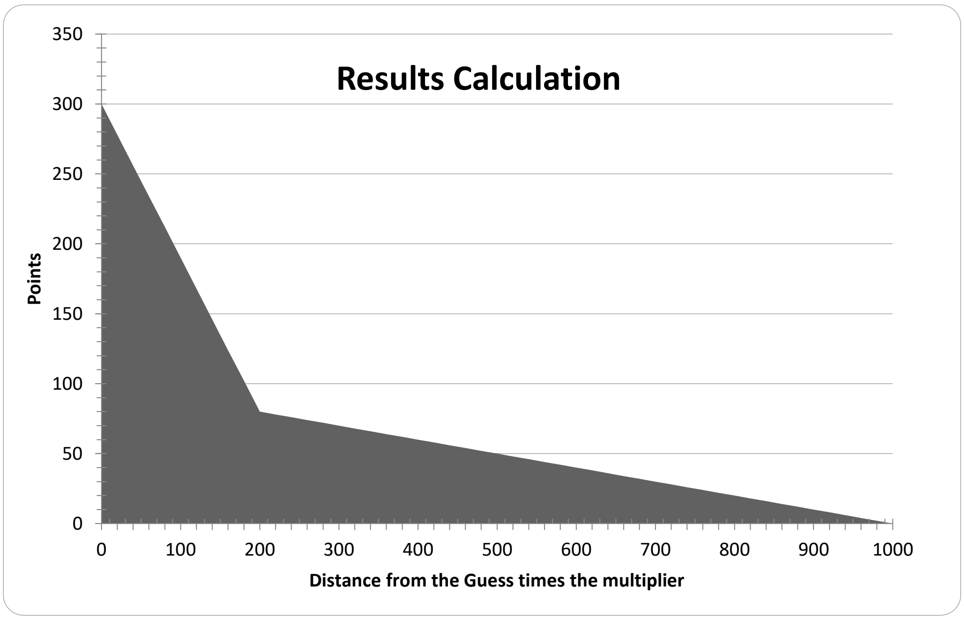
*[Player A would get the most points if s/he guessed the perfect guess of 200*2 = 400. Instead, s/he guessed 300 and is therefore 100 units away from the perfect guess]*

*[Player B would get the most points if s/he guessed the perfect guess 300*2 = 600. Instead, s/he guessed 200 and is therefore 400 units away from the perfect guess]*

The graph on the board (ENUMERATOR: Please point to the graph below, which should be printed and placed on the board) shows exactly how points are calculated, based on how far your guess is from the perfect guess, which is your opponent's guess times your multiplier.

In the example above, Player A earned 180 points, since the guess is 100 units away from the perfect guess and Player B earned 70 points, since the guess is 400 units away from the perfect guess.

You don't need to worry about the details in the graph. Just know that the further you are from the perfect guess, the fewer points you make!



You will play this type of game 22 times over the course of the experiment.

At the end, we will randomly choose one game and we will convert every point you made in that game into 300 TSh.

So, for example, if you earn 100 points in that game, we will pay you 30,000 TSh.

Please play every game carefully, as every game could be the one that determines your earnings at the end.

This is the end of the instructions. Any questions?

YOU CAN NOW START. AS PART OF THE EXPERIMENT, YOU WILL RECEIVE SOME INFORMATION AND YOU WILL BE ASKED SOME QUESTIONS ALONG THE WAY, PLEASE READ CAREFULLY AND PAY ATTENTION TO THE INFORMATION PROVIDED.

3

C Questionnaire prompts

Figure C1: Introductory Message

Figure C2: Sample Presentation of Game Parameters

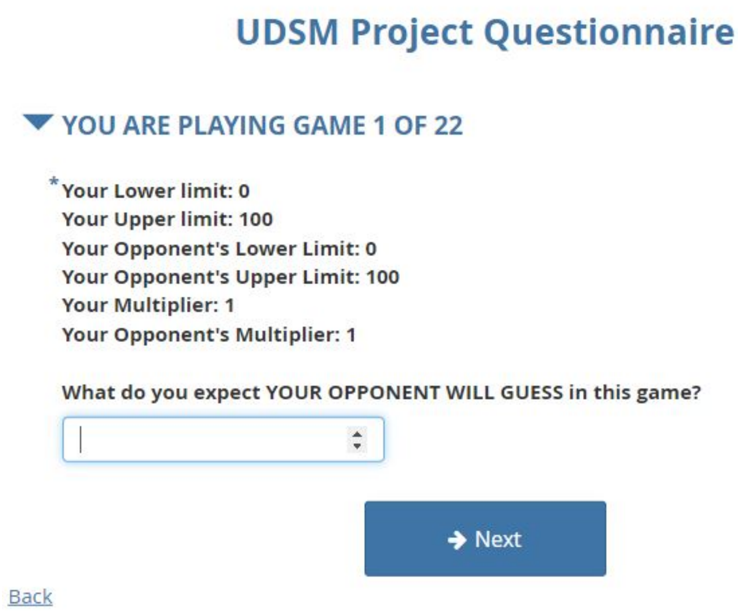


Figure C3: Sample Presentation of Opponent (Combined Treatment)

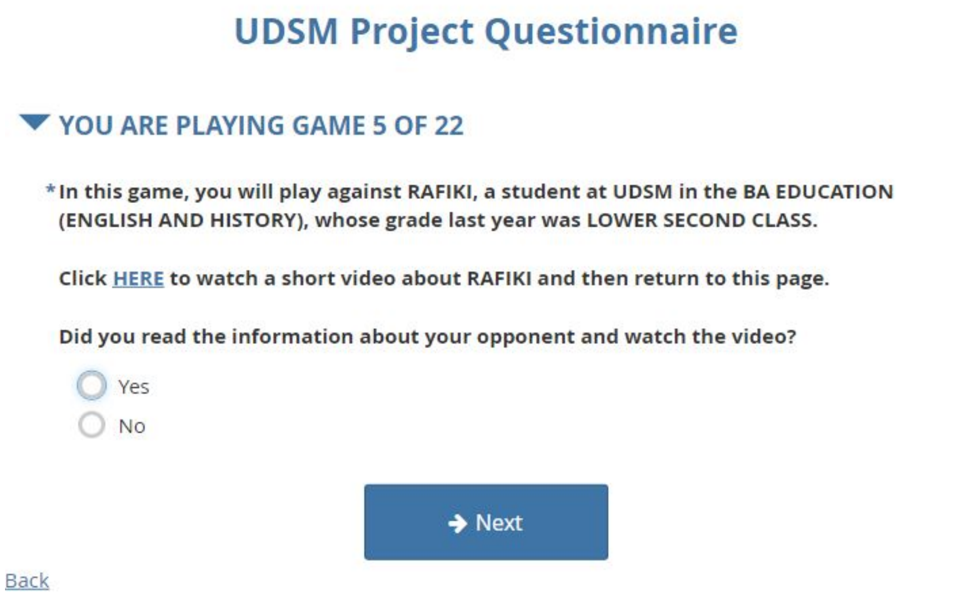


Figure C4: Screenshots from two videos