Absolute vs. relative success: Why overconfidence is an inefficient equilibrium

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Abstract

Overconfidence is common in negotiations and often leads to costly delays and agreement failures. In light of these costs, the persistence of overconfidence in negotiation is puzzling. Hence, we posit that overconfidence might yield important relative benefits that offset its absolute costs. We conducted an experiment (N=298 university students) in which pairs of participants bargain over the unequal allocation of a prize that was earned via a joint effort. To investigate the causal effect of negotiators’ beliefs about their relative contribution on the outcome of the negotiation, we manipulate participants beliefs about their performance using a binary noisy signal. Our results provide evidence that overconfidence leads simultaneously to relative benefits (how one performs compared to one’s partner) but absolute costs (how much money one receives). These results suggest that overconfidence creates an inefficient equilibrium whereby overconfident negotiators benefit over their partners even as they bring about joint losses.

**Keywords:** Overconfidence, motivated beliefs, negotiation

Statement of Relevance

Overconfidence is one of the most well-documented biases in the social sciences, but the evidence regarding its costs and benefits is mixed. We present an experiment that attempts to reconcile these inconsistent findings by investigating the tension between relative and absolute costs and benefits. Our findings suggest that high levels of confidence can lead to an inefficient equilibrium. They also provide an explanation for why overconfidence is both costly and ubiquitous, high levels of confidence can enhance relative success at an absolute cost.
Overconfidence is a root source of many of the world’s catastrophes, conflicts, and ill-conceived enterprises (Johnson, 2009, Trivers, 2011). For example, in the case of economic decisions, overconfident traders take too much risk (Barber & Odean, 2001) and overconfident CEOs make poor decisions regarding investments and mergers (Malmendier & Tate, 2005). In negotiations, overconfidence increases the rate of negotiation failure leading to a waste of resources and opportunity (Babcock et al., 1995, Bazerman & Neale, 1982, Neale & Bazerman, 1985). Despite such costs, overconfidence is also ubiquitous, raising important questions about its causes and possible benefits.

In a provocative theory, Trivers proposed that overconfidence emerges as a strategy for deceiving others (Trivers, 1976, 1985, von Hippel & Trivers, 2011). Consistent with this possibility, evidence suggests that people defer to overconfident others (Anderson et al., 2012, Murphy et al., 2015) in part because overconfidence is persuasive (Schwardmann & van der Weele, 2019, Soldà et al., 2019). For example, optimistic lawyers are more successful in extracting favourable settlements (Bar-Gill, 2005), overconfident job applicants are perceived as more qualified (Ronay et al., 2019), and overconfident negotiators generate higher gains compared to well-calibrated ones, conditional on reaching an agreement (Benos, 1998, Heifetz & Spiegel, 200, Kyle & Wang, 1997). Indeed, a consistent finding from the negotiation literature is that the more people demand, the more they get (Galinsky & Mussweiler, 2001, Moore, 2004, White & Neale, 1994), and greater confidence leads to greater demands (Kramer et al., 1993, McGillicuddy et al., 1984, Thompson & Loewenstein, 1984).

One way to reconcile these inconsistent findings on the costs and benefits of overconfidence is to consider whether the benefits are relative or absolute. Natural selection is theorized to select for traits that yield a relative benefit over other members of the species (Orr, 2009), and sexual selection also selects for attractiveness or competitiveness compared to others, as mating is a choice among alternatives. Evolution thereby ensures that individuals are highly attuned to social status, or in other words, with relative outcomes (Buss, 1989, Brosnan & De Waal, 2003). With regard to overconfidence, the costs tend to manifest in absolute terms (e.g., failure or injury), but the benefits emerge primarily in relative or inter-personal terms (Anderson et al., 2012, Murphy et al., 2015, Murphy et al., 2018). Relative and absolute benefits typically go hand-in-hand, but
relative benefits can accrue an absolute cost (e.g., when a status competition injures both parties but yields a clear winner).

In the current investigation we examine the relative and absolute costs and benefits of high levels of confidence in negotiations. Negotiations are an example of “mixed motives” games, characterized by a blend of cooperative incentives (reaching a deal) and conflictual incentives (reaching a better deal) (Schelling, 1961). This blend of incentives—present in many social interactions—creates a trade-off between being conciliatory and intransigent. In such a context, high levels of confidence can generate relative benefits and absolute costs. By enhancing intransigence, higher levels of confidence might improve ones’ outcome relative to others while simultaneously reducing the chances of a successful negotiation, to the detriment of both parties.

To test this possibility, we adapted an experimental design from the game “Divided” (van Dolder et al., 2015), in which pairs of participants must agree on how to allocate shares of a prize resulting from a joint effort. The prize can only be allocated unequally, to avoid the common default to share any joint outcome 50/50, and participants negotiate over who gets the larger share. Prior to the negotiation, we provided “noisy” feedback to participants to suggest they either performed better or worse than their partner, to isolate the causal effect of participants’ beliefs about their relative contribution to the joint prize on the outcome of the negotiation. We hypothesized that high levels of confidence can lead to an inefficient equilibrium, whereby more confident negotiators do relatively better than less confident ones, but pairs of negotiators who are both high in confidence earn less money than pairs of less confident negotiators.

Method

The experimental design and hypotheses were pre-registered on AsPredicted and can be found here: https://aspredicted.org/bj9er.pdf (note that we have occasionally clarified the hypotheses for expositional purposes). Additionally, we relegated the hypotheses and analyses on agreement failures to the SOM-R (section 2). No data point was excluded from the analyses.

Participants: We recruited a total of 298 participants via Hroot (Bock et al., 2014), mainly among students from local engineering, business, and medical schools in Lyon, France. The experiment was conducted over a series of 21 sessions that involved an average of 14 participants per sessions,
and participation took place in GATE-lab (Ecully, France). Overall, 54% of the participants were female and the average age was 23 years (SD = 5.48).

Participants were paid the sum of their earnings for each phase in addition to a five-euro show-up fee. The experiment took an average of one hour (including payment) and the average payoff was 15.71 euros (SD = 6.72). Participants received their payment in cash and in private at the end of the experiment. Our intent was to run 300 participants. With that sample size, the minimum detectable effect size with statistical power at the recommended .80 level was Cohen’s d=0.32 for mean comparisons between participants who received a good signal vs. a bad signal and Cohen’s d=0.46 for mean comparisons between the four possible combinations of signals (Cohen, 2013).

*Procedure and Measures:* The experiment was programmed using o-Tree (Chen et al., 2016) and was composed of four parts, which we refer to as the ‘individual phase’, the ‘partner phase’, the ‘manipulation phase’, and the ‘negotiation phase’. We use the individual phase to match participants in pairs. In the partner phase, both participants in a pair answer general knowledge questions to build a joint prize. In the manipulation phase, we elicit participants’ beliefs about their performance in the partner phase relative to their partner’s performance. In the negotiation phase, pairs of participants negotiate the allocation of their shared prize. The unfolding of the experiment is displayed in Figure 1. Translated experimental instructions are available in the SOM-U (section 1.2).
Fig. 1. Schematic representation of the experimental design. Participants take a quiz and their correct answers contribute to a joint prize. After the quiz, they receive noisy feedback about who is likely the best performer in the pair. The prize money is then divided into two unequal shares and participants claim the share they want. If they claim the same share, they can argue via chat for up to three minutes, at which point the shares start shrinking. The value of the prize diminishes steadily to zero after 30 seconds if no agreement is reached.

**Individual phase.** Participants answered ten general knowledge questions individually. For each question, they were to choose the correct answer from among four options. Participants received 0.2 euro for each correct answer. At the end of the individual phase, participants were ranked according to their performance on the quiz. The participant with the highest score was ranked 1 and the participant with the lowest score was ranked $n$ (with $n$, the total number of participants in the session). Participants were not informed of their rank, but they receive information about their score and their payoff for this stage at the end of the experiment.

**Partner phase.** Participants were matched in pairs according to their rank: The participant ranked $n$ was matched with the participant ranked $n−1$, the participant ranked $n−2$ was matched with the participant ranked $n−3$, and so on until all participants were paired. This pairing procedure was
common knowledge among participants and was intended to clarify that both members are able to contribute to the joint prize more or less equally. Participants then answered 30 general knowledge questions individually. The questions used in both stages of the experiment are available in the SOM-U (section 1.3). As in Part I, the questions were the same for all participants and they were to choose the correct answer among four options. Participants received 0.67 euro for each correct answer. The money earned by both participants in each pair was allocated to a joint account. To prevent participants from inferring their performance from the value of their joint account (and hence their partner’s performance), we added a random shock $e \in [-0.85, 1.15]$ to the productivity of the pair. For the same reason, we set the piece-rate equal to a number with two decimal points. If we denote $p_i$ the number of correct answers of participant $i$ and $p_j$ the number of correct answers of participant $j$ from the pair $\{i,j\}$, the value $v$ of the joint prize of pair $\{i,j\}$ is computed: $v_{ij} = 0.67*e*(p_i+p_j)$.

**Manipulation phase.** After participants completed the 30 general knowledge questions, we elicited their beliefs about their absolute and relative performance in the partner phase. First, participants were asked to report their beliefs about the number of questions they answered correctly in the partner phase. Participants received 1 euro if their estimate was exact or deviated from their true performance by only one question, and 0.50 euro if their estimate deviated from their true performance by two questions. If the estimate deviated by more than two questions, they did not earn or lose anything. Participants were then asked how likely it is that they outperformed their partner in the partner stage. Participants indicated their belief on a scale from 0 to 100% on a slider without incentives.

We then manipulated participants’ belief about their relative performance by giving them a private ‘noisy’ binary signal, using a procedure adapted from Schwardmann and van der Weele (2019). The ‘noisy’ feedback is designed to create random variation in participants’ confidence about their relative contribution, without deception. Each participant was shown two cyber-urns containing twenty balls of two different colours (red and green), and was told that the computer program selects a ball from one of these two urns. If the participant performed better than his partner in the partner phase, the ball is drawn from the urn with fifteen green balls and five red balls. If the participant performed worse than his partner in the partner phase, the ball is drawn from the urn with five green balls and fifteen red balls. Therefore, a participant who outperformed his partner
is more likely to see a green ball and a participant who was outperformed by his partner is more likely to see a red ball. We then elicited participants’ beliefs about their relative performance in the partner phase again. After the final belief elicitation, the value $v_{ij}$ of the joint prize was displayed on the screen and participants were asked to decide how to share their prize via a three-stage negotiation process. Participants had been told that they would split the prize in the partner phase, but were only given instructions on the details of the split and the negotiation procedure after the last belief elicitation.

**Negotiation phase.** Participants were informed that their joint prize has been divided into two unequal shares. Their task is to reach an agreement on the allocation of these shares. The large share is equal to 70% of the joint prize ($0.7v_{ij}$) and the small share is equal to 30% of the joint prize ($0.3v_{ij}$). The negotiation process is divided into three stages. Participants have the opportunity to reach agreement in each of the three stages. However, $v_{ij}$ decreases in stage three. The unfolding of the stages is described to participants before they enter the negotiation process.

In Stage 1, participants were asked to claim either the high share or the low share and to write a message to their partner to justify their choice. There was no time constraint in this stage. If both negotiators from the same pair claimed different shares, an agreement was reached: the participant who claimed the large share receives $0.7v_{ij}$ and the participant who claimed the small share receives $0.3v_{ij}$. In this case, the negotiation process ends in Stage 1 and participants do not enter Stage 2 or Stage 3. If both negotiators claimed the large share in Stage 1, they proceed to Stage 2. Both participants also enter Stage 2 if they both choose the small share in Stage 1, however, this situation never occurred in our experiment.

In Stage 2, participants who did not agree in Stage 1 were given three additional minutes to try to reach an agreement. During these three minutes, participants could communicate via a chat box with their partner. The communication within pairs was only restricted in two ways: participants were not allowed to reveal the colour of the ball that was shown to them nor any private information that would remove their anonymity. They were reminded of the amount allocated to each share, their own decision in Stage 1, and their partner’s decision in Stage 1. They could decide to switch from the large share to the small share at any time by hitting the corresponding button on their screen. An agreement was reached when one of the negotiators in the pair switched from the large share to the small share. In this case, the participant who claimed the large share received
0.7v_{ij}, the participant who claimed the small share received 0.3v_{ij}, and the negotiation ended. If no agreement was reached within the allocated time, participants proceeded to Stage 3.

In Stage 3, participants were given thirty additional seconds to try to reach an agreement. For each second spent in this stage, the value of joint prize and hence amount in each share decreased linearly and proportionally, such that both shares were equal to zero at the end of the thirty seconds. Participants could observe on their screen the value of the shares decreasing in real time (i.e., shrinking every second). The shares stopped shrinking when one participant chose the small share. In this case, the participant who chose the large share received the remaining amount allocated to the large share, and the participant who switched to the small share received the remaining amount allocated to the small share. If no one switched before the end of the thirty seconds, both negotiators received nothing, and the total value of the joint prize was lost.

At the end of the negotiation phase, participants completed a demographics questionnaire in which they were asked to report their gender, age, and their risk preferences. We elicit risk preferences by asking participants to indicate how willing there were to take risks in general on a scale from 0 to 10 (Dohmen et al., 2005).

**Results**

Figure 2 displays participants’ average beliefs about their relative performance before they received the ‘noisy’ signal (light bars) and after they observed the signal (dark bars). Because participants were not given any information about their performance or their partner’s performance prior to the signal, their prior beliefs about how they performed relative to their partner should not differ significantly from 50% (Mann-Whitney tests: Z = -0.228, p = 0.820, Somers’ d = 0.012 with 95% CI = [-0.202, 0.225] for participants who received a bad signal and Z = 1.216, p = 0.224, Somers’ d = -0.067 with 95% CI = [-0.158, 0.293] for participants who received a good signal).\(^1\)

To highlight differences from this theoretical baseline, we normalized participants’ prior and posterior beliefs at 50 by subtracting 50 from each individual belief.

\(^1\) Note that all p-values are two-tailed.
Fig. 2. Participants’ beliefs (normalized at 50) about their performance relative to their partner before they received the signal (light bars) and after they observed the signal (dark bars), by signal valence. The left-hand side of the graph shows the average beliefs for participants who received a bad signal (n=150) and the right-hand side shows the average beliefs for participants who received a bad signal (n=148).
There were no significant differences in prior beliefs conditional on the signal (Mann-Whitney test: $Z = -1.015$, $p = 0.310$, Somers' $d = 0.037$ with 95% CI = [-0.035, -0.110]), but a significant difference emerged in posterior beliefs consistent with the signal received (Mann-Whitney test: $Z = -11.74$, $p < 0.001$, Somers' $d = 0.413$ with 95% CI = [0.372, 0.454]). Participants who received a bad signal shifted their beliefs down by 12.04 percentage points (Wilcoxon signed-rank equality tests: $Z = 8.472$, $p < 0.001$, Somers' $d = 0.649$ with 95% CI = [0.412, 0.886]) and participants who received a good signal shifted their beliefs up by 17.12 percentage points (Wilcoxon signed-rank equality tests: $Z = -10.02$, $p < 0.001$, Somers' $d = -0.845$ with 95% CI = [-1.057, -0.632]). This difference in updating suggests an asymmetry in the assimilation of good vs. bad news (Mann-Whitney test of change in beliefs between signals: $Z = -2.823$, $p = 0.005$, Somers' $d = 0.103$ with 95% CI = [0.032, 0.174]), which is consistent with prior research (Eil & Rao, 2011, Möbius et al., 2014, Sharot et al., 2012).

We predicted that negotiators who were led to believe they outperformed their partner would receive a larger fraction of the joint prize at the end of the negotiation. To test this hypothesis, we examined negotiation outcomes across the different feedback combinations. For each pair of participants $\{i,j\}$ we have four possible combinations of signals: $i$ received a bad signal/$j$ received a good signal, both $i$ and $j$ received a bad signal, both $i$ and $j$ received a good signal, $i$ received a good signal/$j$ received a bad signal. The pairs of payoffs associated with each of these combinations are displayed Table 1. We investigated both absolute and relative outcomes (see left and right panels of Table 1). Absolute payoffs are measured as the percentage of the initial prize received by each participant after the negotiation. This measure incorporates the possible loss of prize money in the negotiation process: When the prize money shrinks, the sum of absolute payoffs progressively goes towards zero. In contrast, relative payoffs are measured as the share of the final prize (i.e., the remaining amount of the joint prize at the end of the negotiation) received by each participant. Relative payoffs only reflect how well players do compared to each other, not relative to the initial amount they could have received.

In terms of absolute payoffs, the average payoffs were lower when both participants received good signals than when both received bad signals (left panel of Table 1). For pairs of participants who received opposite signals, the participant with the good signal received more than the participant with the bad signal. These effects did not emerge with relative payoffs, where the only costs were
associated with receiving a bad signal when one’s partner received a good one (right panel of Table 1).

Table 1. Players’ payoffs as a function of their own signal and the signal of their partner.

<table>
<thead>
<tr>
<th>Absolute Payoffs</th>
<th>Relative Payoffs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Player j</strong></td>
<td><strong>Player j</strong></td>
</tr>
<tr>
<td><strong>Signal</strong></td>
<td><strong>Good</strong></td>
</tr>
<tr>
<td>Good</td>
<td>26.96%</td>
</tr>
<tr>
<td>(n=46)</td>
<td></td>
</tr>
<tr>
<td>Bad</td>
<td>44.46%</td>
</tr>
<tr>
<td>(n=102)</td>
<td></td>
</tr>
</tbody>
</table>

To assess whether these patterns are due to the causal effect of participants’ confidence on their negotiation outcomes, we estimated the effect of participants’ posterior beliefs about their relative contribution on their negotiation outcomes, using the noisy signals as instrumental variables in a two-stage least squares (2SLS) regression. The feedback signal is informative about the true state of the world (i.e., whether the participant performed better than her partner in the partner phase) and, consequently, shifts participants’ beliefs. However, conditional on their performance, these signals are purely random and therefore provide a source of exogenous variation in beliefs. To ensure that the feedback can only influence outcomes through its impact on private beliefs regarding relative performance, participants were not allowed to discuss their feedback directly with their partner. These features of the design ensure the validity of our instrumental analysis.

The upper panel of Figure 3 shows that an increase in participant i’s confidence leads to an increase in her absolute payoff, when her partner j has low confidence (belief j = 20%, see the blue line). However, when the partner j has a high confidence (belief j = 80%), participant i is penalized for having a higher confidence (see the red line). This interaction between the confidence of a participant and her partner’s confidence is significant ($\beta = -0.0145$, $p = 0.006$, 95% CI = [-0.0247, -0.0042]). These results confirm that the pattern observed in the left panel of Table 1 is driven by
variation in confidence generated by the noisy feedback participants received rather than pre-existing beliefs of the participants.

Fig. 3. Linear prediction (with 95% confidence interval) of the effect of participant $i$’s belief on participant $i$’s absolute (upper panel) and relative (lower panel) payoffs when participant $j$’s belief is low (red line) or high (blue line). The estimates are from models (1) and (9) in Table S1 of the SOM-R, respectively.
In contrast, the relative payoffs are symmetric when both participants have the same degree of confidence (either high or low), with no such interaction in the lower panel of Figure 3. While the effect of a participant’s own confidence approaches significance ($\beta = 0.157$, $p = 0.059$, 95% CI = [-0.0059, 0.320]), having greater confidence than one’s partner has a positive effect on relative payoffs secured ($\beta = 0.154$, $p < 0.001$, 95% CI = [0.142, 0.166]). These estimates again confirm that the pattern observed in the right panel of Table 1 reflects the causal effects of beliefs on payoffs. Overall, these results suggest that higher levels of confidence can be beneficial in relative payoffs, even when they come at a cost in absolute payoffs.

Other aspects of the negotiation process also suggest that high levels of confidence within pairs of negotiators lead to conflictual negotiations and hence to a smaller final prize. Figure 4 displays the percentage of agreements reached in each stage of the negotiation process. Overall, 6.04% of the pairs reached an agreement in stage 1, 36.24% in stage 2 (seconds 1 to 180) and 42.95% in stage 3 (seconds 181 to 210). 14.77% of pairs did not reach an agreement at all and came up empty-handed. The spikes around 180 seconds suggests that most pairs agreed either at the end of the 3 minutes in stage 2 (14.77%) or immediately when the shares start to shrink in stage 3 (32.89%). Fig. 4 shows that delays or failures to reach an agreement occurred frequently, suggesting a substantial amount of the initial prize was lost in the negotiation process. Such failures are driven in part by pairs of negotiators who are both high in confidence. The left panel of Table 1 shows that the average percentage of the initial prize awarded at the end of the negotiation among pairs of participants who received two good signals is 26.43% lower than the share awarded to pairs of participants who received signals of opposite valence (Mann-Whitney test: $Z = 2.453$, $p = 0.014$, Somers’ $d = -0.12$ with 95% CI = [-0.217, -0.0136]).
Fig. 4. Distribution of the time needed to reach an agreement (in seconds) across all pairs (n=149). Stage 1: participants only state their preferred share. Stage 2: participants can argue about their preferred share. Stage 3: the shares shrinks to zero over 30 seconds if participants do not reach an agreement.

To further investigate the causal effect of confidence on the outcome of the negotiation, we estimated the effect of the sum of participants’ beliefs on the percentage of the initial prize that remained to be shared after the negotiation. We instrumented the sum of beliefs with the noisy signals using 2SLS regression, as the noisy signals create exogenous variation in the overall sum of confidence in the pair. Results are displayed in Table 2. Models (1) and (2) in Table 2 show that a 10% increase in confidence at the pair level leads to a 4% decrease in the percentage of the initial prize that is awarded after the negotiation ($\beta = -0.422, p = 0.020, 95% \ CI = [-0.778, -0.0671]$). Models (3) and (4) show a similar effect when considering only pairs of negotiators who reached an agreement before the end of the negotiation process ($\beta = -0.363, p = 0.003, 95% \ CI = [-0.599 \ to \ -0.127]$), suggesting that losses are not only driven by agreement failures but delays as well. These
results provide evidence that high levels of confidence lead to conflict that is detrimental for the outcome of the negotiation process.

Table 2. Effect of confidence on the outcome of the negotiation.

<table>
<thead>
<tr>
<th>Dependent var.:</th>
<th>Remaining percentage of the initial prize</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Belief(_i) + Belief(_j)</td>
<td>-0.422</td>
</tr>
<tr>
<td>p-values</td>
<td>0.020</td>
</tr>
<tr>
<td>95% CI</td>
<td>-0.778 to -0.0671</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
</tr>
<tr>
<td>Constant</td>
<td>120.72</td>
</tr>
<tr>
<td>p-values</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>95% CI</td>
<td>82.38 to 159.06</td>
</tr>
<tr>
<td>Obs</td>
<td>149</td>
</tr>
<tr>
<td>F-Stat first stage</td>
<td>27.59</td>
</tr>
<tr>
<td>Chi2</td>
<td>5.43</td>
</tr>
</tbody>
</table>

Note: Columns (1) to (4) report the 2SLS estimates of the sum of beliefs of participant \(i\) and \(j\) from the pair \(\{i,j\}\), instrumented by both \(i\) and \(j\) signals on the percentage of the initial prize that is awarded at the end of the negotiation process. Columns (1) and (2) show the results for all pairs. Columns (3) and (4) show the results only for pairs of participants who reached an agreement. Controls include both participant \(i\) and \(j\)’s performance in the partner phase, gender, age, and risk preferences.

Discussion

Overall the absolute payoffs suggest that when both players have a high level of confidence the situation is not in equilibrium. When one player is highly confident the other player is better off being less confident, as they both receive a higher payoff. In contrast, when one player is not very confident the other player is better off being highly confident. These findings suggest that, in terms
of absolute payoffs, high levels of confidence are beneficial in negotiation only when your partner is low in confidence. In contrast, when the game is considered in terms of relative payoffs, the situation where both players have high levels of confidence is an equilibrium because neither negotiator has an incentive to be less confident. If Player $i$ is not confident, Player $j$ is better off being confident and if Player $i$ is confident, Player $j$ is also better off being confident. These results suggest that when people are in mixed-motive situations, the goal to achieve higher relative outcomes could favour the emergence of overconfidence, even though it can have cost in absolute payoffs.

Limitations: In addition to generalizability concerns associated with our choice of sample (composed entirely of students from a single country), it is worth noting that our negotiation task was explicitly designed to make delay costly. It was also designed to increase the probability of disagreement by mandating that the distribution be unfair, as people reject unfair offers for good reason (Nowak et al., 2000). Thus, future research might consider the cross-cultural reliability of these findings, as well as their likelihood of emerging in less contentious circumstances.

Conclusions: The results of this experiment suggest that high levels of confidence can emerge as an inefficient equilibrium in negotiations: a negotiator is relatively better off being more confident independent of whether the other is also confident. Such enhanced relative outcomes could select for strategically inflated self-beliefs, with the end result that overconfidence is widespread. Nevertheless, this strategy comes at a cost, as both partners earn more in absolute terms when they are less confident. These data suggest that overconfidence should be widespread in contexts in which individuals prioritize relative over absolute gains. These findings also provide an explanation for why overconfidence is both costly and ubiquitous, evolution can select for traits that enhance relative status even at an absolute cost.
Acknowledgments

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References


To investigate the causal effect of the participants’ confidence on their payoffs received from the negotiation, we regress both the absolute payoff (as a percentage of the initial joint prize) and the relative payoff (as a percentage of the final prize) on the posterior beliefs of participants i and j about their relative contribution to the joint prize, as well as the interaction between the two players’ posterior beliefs.

We instrument each participants’ posterior belief in a pair (belief_i or belief_j) by a dummy variable equal to 1 if a good signal was observed, and 0 otherwise. In addition, we instrument the interaction between the two players’ beliefs by the combination of signals received, as they are determined by only one participant (who switched from the high share to the low share), and the interaction between the two players’ posterior beliefs. We instrument each dependent, as they are determined by only one participant (who switched from the high share to the low share), we use 1000 bootstrap replications with samples of one draw per pair (i.e. for each replication, one participant from each pair is randomly selected as an observation). To control for the potential correlation between the error terms of the three equations, we estimate the models using 3SLS. The estimated coefficients are displayed in columns (1) and (7) in Table S2.1. Columns (2) and (8) show the same estimation with more control variables (both participant i and j’s absolute performance in the partner phase, as well as participant i’s gender, age and risk preference).

### Table S1. Effect of beliefs on participants' payoff from the negotiation.

<table>
<thead>
<tr>
<th>Dependent var.</th>
<th>Absolute percentage awarded</th>
<th>Relative percentage awarded</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
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<tr>
<td>Belief_i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-values</td>
<td></td>
<td></td>
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<tr>
<td>95% CI</td>
<td></td>
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<tr>
<td>Belief_j</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td></td>
<td></td>
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<tr>
<td>Belief_i*Belief_j</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-values</td>
<td></td>
<td></td>
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<tr>
<td>95% CI</td>
<td></td>
<td></td>
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<tr>
<td>Belief_i-Belief_j</td>
<td></td>
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<tr>
<td>p-values</td>
<td></td>
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<tr>
<td>95% CI</td>
<td></td>
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<tr>
<td>Controls</td>
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<tr>
<td>No</td>
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<tr>
<td>p-values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>298</td>
<td>298</td>
</tr>
<tr>
<td>R-Squared</td>
<td>-0.0540</td>
<td>-0.0616</td>
</tr>
<tr>
<td>Chi2</td>
<td>20.01</td>
<td>22.13</td>
</tr>
</tbody>
</table>

Note: Table S1 shows the effect of participant i’s and j’s beliefs on participant i’s absolute payoffs (columns (1) to (6)) and relative payoffs (columns (7) to (12)). Columns (1) and (2) display the 3SLS estimates of participant i’s and j’s beliefs, as well as their interaction on participant i’s absolute payoff. Columns (3) and (4) display the same estimates after removing the interaction term. Columns (5) and (6) display the 2SLS estimates of the difference in beliefs between participant i and j on participant i’s absolute payoff. Columns (7) to (12) display the same set of estimates using participant i’s relative payoffs as the dependent variable. Control

---

1 Both participant i and j’s relative payoff are set to 50% for pairs who failed to reach an agreement.
variables include participant i and j’s absolute performance in the partner phase, as well as participant i’s gender, age and risk preference. We use 1000 bootstrap replications with samples of one draw per pair.

Because the interaction term is not significant in the context of relative payoff, we can remove it from the equation.\(^2\) We re-estimate models (7) and (8) without the interaction term and the new estimates are displayed in columns (9) and (10), respectively. Because the coefficients associated with participant i and j’s posterior beliefs are perfectly symmetric, we can also estimate a joint coefficient using the difference in beliefs between participant i and participant j as the main independent variable. Column (11) shows the estimates of the 2SLS regression of participant i’s relative payoff on the difference in beliefs between participant i and participant j, instrumented by both participant i’s and participant j’s signals. Column (12) displays the same estimates, when adding the same control variables as in models (8) and (10).

For completeness, we also performed the same estimations as in columns (9) to (12) using the absolute payoff received by participant i as the dependent variable. The estimates are displayed in columns (3) to (6). However, these models do not consider the existence of an interaction between participant i’s and participant j’s beliefs and should be interpreted in this light.

2. Pre-registered Analyses

This section reports the pre-registered analyses that are missing from the main text, as they are secondary to our primary research question.

2.1 Confidence and likelihood to concede

We pre-registered that we would investigate the effect of confidence on the likelihood of accepting the small share. Table S2 displays the percentage of participants who accept the small share for pairs that agreed in (1) Stage 2, (2) in Stage 1 or 2, in (3) Stage 3, and (4) overall, conditional on the signal they received.\(^3\)

Table S2 – Proportion of participants who accept the small share, by stage and signal received.

<table>
<thead>
<tr>
<th>Signal</th>
<th>% of participants who accept the small share in</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stage 2</td>
<td>Stage 1 or 2</td>
<td>Stage 3</td>
<td>All stages</td>
</tr>
<tr>
<td>B</td>
<td>68.97%***</td>
<td>69.57%***</td>
<td>49.18%</td>
<td>60%***</td>
</tr>
<tr>
<td></td>
<td>(6.13)</td>
<td>(5.58)</td>
<td>(6.45)</td>
<td>(4.31)</td>
</tr>
<tr>
<td>G</td>
<td>28%</td>
<td>26.32%</td>
<td>49.25%</td>
<td>38.71%</td>
</tr>
<tr>
<td></td>
<td>(6.41)</td>
<td>(5.88)</td>
<td>(6.15)</td>
<td>(4.39)</td>
</tr>
<tr>
<td>Obs.</td>
<td>108</td>
<td>126</td>
<td>128</td>
<td>254</td>
</tr>
</tbody>
</table>

Note: Table S2 shows the proportion of participants who concede to the small share in different stages of the negotiation process, conditional on the signal they received. Standard errors in parentheses. Asterisks indicate the results of two-sample tests of proportions. *** p<0.001, ** p<0.01, * p<0.05.

Participants who received a good signal are significantly less likely to accept the small share in Stage 2 than those who received a bad signal and the difference remains significant when adding participants who agreed in Stage 1 (two-tailed tests of proportion:\(^4\) Stage 2: z = 4.25, p < 0.001, Somers’ d = -0.41 with 95% CI = [-0.582, -0.233], Stage 1 or 2: z = 4.83, p <0.001, Somers’ d = -0.43 with 95% CI = [-0.587, -0.270]). This

\(^2\) The fact that relative payoffs are perfectly symmetric (50% each) when both participants have the same degree of confidence (either high or low) is a strong indication that there should be no interaction between participants’ beliefs within the same pair.

\(^3\) We pool observation from Stage 1 and 2 due to the very small number of pairs who reached an agreement in Stage 1 (9 pairs only).

\(^4\) PR test hereafter.
difference disappears in Stage 3 in which the share starts to shrink (PR test: $z = -0.01, p = 0.993$, Somers’ d = -0.01 with 95% CI $= [-0.174, 0.176]$), which might be driven by the toughest negotiators being self-selected to enter the last stage. Over all stages, among all the pairs that researched agreement, those who received a good signal are significantly less likely to accept the smaller share than participants who received a bad signal (PR test: $z = 3.39, p < 0.001$, Somers’ d = -0.21 with 95% CI $= [-0.334, -0.092]$). Probit regressions of the likelihood to switch from the large share to the small share on the difference in beliefs between participants $i$ and $j$ from a pair $\{i,j\}$, instrumented by the signals received by both $i$ and $j$ produce similar results (see SOM-U section 2.2).

### 2.2 Confidence and agreements

To investigate the causal effect of confidence on the likelihood to reach an agreement, we pre-registered that we would estimate a probit regression of a dummy variable equal to 1 if the pair reached an agreement before the end of the negotiation process (and 0 otherwise), on the difference in posterior beliefs between participants $i$ and $j$ instrumented by both $i$’s and $j$’s signals. We also pre-registered that we will estimate a 2SLS regression and a Poisson regression of the stage at which an agreement is reached on the difference in posterior beliefs between participants $i$ and $j$, instrumented by both $i$’s and $j$’s signals. We later realized that the estimations of these models had some limitations. These limitations are discussed in section 2.4 of the SOM-U where we propose new estimation strategies.
## Table of content

1. Instructions .................................................................................................................. 2
   1.1 Original Instructions (in French) ............................................................................. 2
   1.2 Translated Instructions ......................................................................................... 9
   1.3 General Knowledge Test Items ............................................................................. 16

2. Additional Analyses .................................................................................................... 19
   2.1 Summary Statistics ............................................................................................... 19
   2.2 Comments on Table S2.1 interpretations and Robustness checks ......................... 19
   2.3 Confidence and signals .......................................................................................... 21
   2.4 Agreement failures and delays ............................................................................... 22
   2.5 Likelihood to concede ............................................................................................ 24
   2.6 Biases in Beliefs Updating ..................................................................................... 25
   2.7 Message Content .................................................................................................... 26
INTRODUCTION

Bienvenue à cette expérience sur la prise de décision. Merci d’éteindre votre téléphone portable et de le ranger. Vous n’êtes pas autorisé(e) à communiquer avec les autres participants pendant l’expérience, à part lorsque cela est clairement indiqué dans les instructions. 

Pendant cette session, vous pouvez gagner de l’argent. Le montant que vous allez gagner dépend de vos décisions et des décisions d’autres participants dans la session. Toutes les décisions que vous prendrez durant la session sont anonymes. Vous recevrez également une indemnité de participation de 5 euros pour vous être présenté à l’heure à cette expérience.

A la fin de l’expérience, vous serez payé(e) en liquide, en privé, dans une salle séparée. Cette session comporte quatre parties. Vous recevrez les instructions de la première partie à la fin de cette introduction. Vous recevrez les instructions pour chaque partie suivante à la fin de la partie précédente. Vous recevrez un exemplaire papier des instructions des parties 1, 2 et 4. Les instructions de la partie 3 seront affichées directement sur votre écran. Si vous avez des questions au cours de l’expérience, appuyez sur le bouton rouge qui se trouve sur le mur à côté de vous et l’expérimentateur viendra vous répondre en privé.

INSTRUCTION - PARTIE 1

Durant cette partie, vous allez entreprendre une tâche individuelle. En travaillant sur la tâche, vous gagnerez des points. A la fin de l’expérience, chaque point sera converti selon le taux de change suivant : 1 point = 0,20€.

La tâche

Vous allez devoir répondre à 10 questions de culture générale sous la forme d’un questionnaire à choix multiple. Ces questions sont les mêmes pour tous les participants. Chaque réponse correcte vous rapportera un point.

Vous aurez 15 secondes par question pour choisir une réponse. Une fois que vous avez fait votre choix, appuyez sur le bouton « Next » pour passer à la question suivante.
Si vous avez sélectionné une réponse dans le temps imparti mais que vous n’avez pas eu le temps d’appuyer sur le bouton « Next », votre réponse sera enregistrée par le programme informatique.

Si vous n’avez pas sélectionné de réponse avant la fin des 15 secondes, vous serez automatiquement redirigé vers la question suivante. Vous ne gagnerez pas de point pour cette question.

***

Si vous avez des questions, veuillez lever la main et nous viendront y répondre en privé. La partie 1 démarrera une fois que tout le monde sera prêt.

INSTRUCTION - PARTIE 2

Formation des groupes

Durant cette partie, vous allez être appariés en groupes composés de deux joueurs. Les paires de participants seront formées en fonction de votre performance dans la Partie 1. Les paires seront formées de la façon suivante : le participant ayant obtenu le score le plus élevé dans la Partie 1 sera apparié avec le participant ayant obtenu le deuxième meilleur score dans la Partie 1. Le participant ayant obtenu le troisième meilleur score dans la Partie 1 sera apparié avec le participant ayant obtenu le quatrième meilleur score dans la Partie 1, et ainsi de suite jusqu’à ce que tous les participants soient appariés à un autre participant. De ce fait, vous serez apparié avec un participant dont la performance est classée la plus proche de la vôtre.

La Tâche

Dans cette partie, la tâche est composée du même type de questionnaire à choix multiple que dans la Partie 1. Le questionnaire comporte 30 questions. Comme en Partie 1, les questions seront les mêmes pour tous les participants. Vous répondrez aux questions individuellement. A la fin de cette partie, vos gains dépendront à la fois de votre performance et de la performance de votre partenaire. Chaque groupe a un compte commun. Chacune de vos bonnes réponses rapportera 1 point à ce compte commun. De même, chacune des bonnes réponses de votre partenaire rapportera 1 point à ce compte commun.

A la fin de la partie, le total des points collectés par vous et votre partenaire sera multiplié par un nombre compris entre 0,85 et 1,15 choisi par le programme informatique, et converti en euro selon le taux de change suivant : 1 point = 0,67€.

Compte commun

La valeur finale du compte commun est déterminée par :
- Le nombre de points que vous avez collectés en Partie 2.
- Le nombre de points collectés par votre partenaire en Partie 2.
- Le taux de change (1 point = 0,67 euro).
- Le numéro/multiplicateur que le programme informatique a choisi pour votre groupe.

Le multiplicateur aléatoire pour votre groupe est déterminé de la manière suivante : le programme informatique va sélectionner aléatoirement une boule d’une urne contenant 31 boules numérotées de 0,85 à 1,15. Le nombre sur votre boule définira le multiplicateur aléatoire pour votre groupe. Par exemple, si le
programme informatique tire une boule portant le numéro 1.05, la valeur de votre compte commun sera égale à la somme des points collectés par vous et votre partenaire, multiplié par 1.05. Vous ne connaîtrez jamais quelle boule a été tiré par le programme informatique.

**En résumé, la valeur finale de votre compte commun est calculée de la façon suivante :**

(le nombre de bonnes réponses que vous avez donné en Partie 2 + le nombre de bonnes réponses données par votre partenaire en Partie 2) * le nombre tiré au sort par le programme informatique * 0.67

A la fin de l’expérience, vous et votre partenaire devrez décider de la répartition du compte commun. Vous recevrez plus d’information sur la répartition du compte commun au début de la Partie 4.

**Pour résumer :**
- Vous allez être apparié avec un participant ayant obtenu une performance proche de la vôtre dans la partie précédente.
- Chacune de vos bonnes réponses rapportera 1 point à votre compte commun.
- Chacune des bonnes réponses données par votre partenaire rapportera également 1 point à votre compte commun.
- Le total des points que vous et votre partenaire avez collecté sera multiplié par un nombre aléatoire compris entre 0.85 et 1.15 et ensuite converti en euro selon le taux de change suivant : 1 point = 0.67 euro.

 Si vous avez des questions, veuillez lever la main et nous viendront y répondre en privé. La partie 2 démarrera une fois que tout le monde sera prêt.

**INSTRUCTION - PARTIE 3 (on screen)**

[belief 1]

Vous avez terminé la Partie 2. Avant de continuer, nous aimerions que vous estimiez le nombre de questions auxquelles vous pensez avoir correctement répondu dans la Partie 2.

Votre estimation sera rémunérée de la façon suivante :
- Si votre estimation est exacte ou dévie de votre performance de seulement 1 réponse (c'est-à-dire que votre estimation dévie de votre performance réelle de plus ou moins une réponse correcte), vous recevrez 1 euro.
- Si votre estimation dévie de votre performance de 2 réponses (c'est-à-dire que votre estimation dévie de votre performance réelle de plus ou moins deux réponse correctes), vous recevrez 0.50 euro.
- Si votre estimation dévie de votre performance réelle de plus de 2 réponses, vous ne recevrez rien.

[belief 2]

Veuillez estimer le pourcentage de chance que vous ayez répondu correctement a plus de questions que votre partenaire entre 0% et 100%.[belief 3 – part 1]

Dans cette partie de l'expérience, vous allez voir une boule tirée de l'une de ces urnes :
- Si vous avez donné moins de réponses correctes que votre partenaire, votre boule proviendra d'une urne contenant 15 boules rouges et 5 boules vertes. Vous aurez donc plus de chance de voir une boule rouge.

- Si vous avez donné plus de réponses correctes que votre partenaire, votre boule proviendra d'une urne contenant 5 boules rouges et 15 boules vertes. Vous aurez donc plus de chance de voir une boule verte.

- Si vous avez donné exactement le même nombre de réponses correctes que votre partenaire, votre boule proviendra de l'une des deux urnes avec une probabilité 50/50. Vous verrez donc une boule verte ou une boule rouge avec la même probabilité.

En conséquence, une boule verte signifie que vous avez plus de chance d'avoir donné plus de réponses correctes que votre partenaire et une boule rouge signifie que vous avez plus de chance d'avoir donné moins de réponses correctes que votre partenaire.

Veuillez appuyer sur "next" quand vous êtes prêt à voir votre boule.

[belief 3 – part 2]

Le programme informatique a aléatoirement tiré une boule. La boule est rouge (verte), cela signifie que vous avez plus de chance d'avoir donné moins (plus) de réponses correctes que votre partenaire.

Avant de continuer, nous aimerions que vous estimiez à nouveau la probabilité que votre performance soit meilleure que celle de votre partenaire.

Veuillez estimer le pourcentage de chance que vous ayez répondu correctement à plus de questions que votre partenaire entre 0% et 100%.

INSTRUCTION - PARTIE 4

Dans cette partie, vous et votre partenaire devez vous mettre d'accord sur la répartition de votre compte commun. La valeur de votre compte commun est affichée sur vos écrans. Vous pouvez uniquement partager le compte commun selon l'allo- cation suivante : l'un de vous recevra 70% (part A) du compte commun ; l'autre participant recevra 30% (part B) du compte commun.

Tout d'abord, vous et votre partenaire devez indiquer la part que vous souhaitez recevoir (A ou B). Vous devrez également envoyer un message à votre partenaire afin d'expliquer pourquoi vous devriez recevoir la part que vous avez indiqué :

- Si vous et votre partenaire choisissez des parts différentes, vous recevrez tous deux la part que vous avez choisi. La partie 4 sera alors terminée.
Si vous et votre partenaire choisissez la même part, vous entrerez tous deux dans la phase de négociation.

* * *

LA PHASE DE NEGOCIATION

Durant la phase de négociation, vous et votre partenaire aurez 3 minutes pour vous mettre d’accord sur la répartition du compte commun. Durant ces 3 minutes, vous aurez la possibilité de négocier avec votre partenaire grâce à une boîte de dialogue.

Interface :

Vous pouvez voir ci-dessous un exemple de l’écran de décision de la phase de négociation :

Temps restant: 1:39

<table>
<thead>
<tr>
<th>Votre choix:</th>
<th>Le choix de l’autre participant:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$14.00</td>
</tr>
<tr>
<td>B</td>
<td>$6.00</td>
</tr>
</tbody>
</table>

Vous avez choisi A.

Dans cet exemple, la valeur du compte commun est de 20 euros. En haut de l’écran, vous pouvez voir les parts A et B et leur valeur respective. La part A correspond à 70% de votre compte commun (14 euros dans cet exemple) et la part B correspond à 30% de votre compte commun (6 euros dans cet exemple).

Vous pouvez utiliser les boutons A et B en bas de votre écran pour choisir soit la part A, soit la part B. Quand vous cliquez sur A ou sur B, votre choix apparaîtra sous « votre choix » dans le tableau. Dans l’exemple ci-dessous, vous avez choisi A. De ce fait, A apparaît sous « votre choix ».

De même, quand votre partenaire clique sur A ou B, son choix apparaîtra sous « le choix de l’autre participant » dans le tableau. Dans cet exemple, votre partenaire a choisi A. De ce fait, A apparaît sous « le choix de l’autre participant ».
Par défaut, le choix que vous avez fait au début de cette partie apparaîtra en dessous de « votre choix » sur votre écran et le choix que votre partenaire a fait au début de cette partie apparaîtra en dessous de « choix de l’autre participant » sur votre écran. Ces informations apparaîtront également sur l’écran de votre partenaire.

Vous pouvez utiliser la boîte de dialogue pour négocier avec votre partenaire. Voici un exemple de la boîte de dialogue :

Après avoir écrit votre message dans le champ de texte en bas de la boîte de dialogue, appuyez sur le bouton « Send » pour envoyer votre message à votre partenaire.

**Conséquence :**

- Si vous ou votre partenaire choisis un autre part différent avant la fin de ces 3 minutes, vous recevrez tous deux la part que vous avez choisi. La partie 4 sera alors terminée.
- Si vous et votre partenaire choisissez la même part, vous aurez 30 secondes supplémentaires pour essayer de parvenir à un accord. CEPENDANT, pour chaque seconde qui passe, les deux parts décroîtront de manière proportionnelle au temps écoulé et vous ne pourrez plus communiquer avec votre partenaire.
  - Si vous et votre partenaire parvenez à un accord dans le temps imparti, le chronomètre s’arrêtera. Le participant ayant choisi A recevra l’argent alloué à la part A lorsque le chronomètre s’est arrêté et l’autre participant recevra l’argent alloué à la part B lorsque le chronomètre s’est arrêté.
  - Vous pouvez changer votre choix à tout moment en appuyant sur les boutons A ou B en bas de votre écran.
  - Si le chronomètre atteint 0 avant que vous ne parveniez à un accord, vous recevrez tous deux 0 euro.
Chat et Messages :

Les règles à respecter IMPERATIVEMENT lors de l’envoi de vos messages sont les suivantes :

- Vous n’êtes pas autorisé à parler de la couleur de la boule que vous avez reçu dans la partie précédente, ou de donner des indices sur la couleur de votre boule.
- Vous n’êtes pas autorisé à proférer des menaces, révéler votre identité, numéro de poste informatique ou toute autre information personnelle pouvant aller à l’encontre de la garantie de votre anonymat.

Si vous ne respectez pas les règles ci-dessus, vous ne recevrez pas votre paiement associé à cette partie de l’expérience.

En résumé :

- Vous devez indiquer quelle part du compte commun vous souhaitez recevoir et envoyer un message à votre partenaire pour justifier votre choix.
- Si vous et votre partenaire choisissez une part différente, vous recevrez tous deux la part que vous avez choisi.
- Si vous et votre partenaire choisissez la même part, vous aurez 3 minutes pour négocier et vous mettre d’accord sur la répartition du compte commun.
- Si votre groupe ne réussit pas à se mettre d’accord avant la fin de ces 3 minutes, vous aurez 30 secondes supplémentaires pour essayer de parvenir à un accord.
- Cependant, durant ces 30 secondes, les montants de chaque part décroîtront de manière proportionnelle au temps écoulé et vous ne pourrez plus communiquer avec votre partenaire.

* * *

Veuillez lire à nouveau ces instructions. Si vous avez des questions, veuillez lever la main et l’expérimentateur viendra vous répondre en privé. Lorsque nous aurons répondu à toutes les questions, la partie 4 commencera.
INTRODUCTION

Welcome to this experiment on decision making. Please turn off your phone and put it away.

You are not allowed to communicate with the other participants in this session except if you are explicitly told to do so in the instructions.

During this session, you can earn money.

The amount of money you will earn depends on your decisions and the decisions of other participants in this session.

All the decisions you will take during this session are anonymous.

In addition, you will receive a show up fee of 5 euros for being on time at the experiment.

At the end of the experiment, you will be paid privately in cash in a separate room.

This session is composed of four parts.

You will receive the instructions for part 1 at the end of this introduction.

You will receive the instructions for each following part after you finish the previous part.

The instructions for Part 1, 2 and 4 will be given to you on papers, and instructions for Part 3 will be directly displayed on your computer screen.

If you have questions during this experiment, you can raise your hand or press the red button on your left and the experimenter will answer you in private.

INSTRUCTION PART 1

For this part of the experiment, you will perform a task individually. By working on the task, you will earn points. At the end of the experiment, each point will be converted according to the following exchange rate: 1 point = €0.20.

The task

Your task is to answer 10 general knowledge questions in the form of a Multiple-Choice Questionnaire. These questions are the same for every participant.

You will earn 1 point for each correct answer.

You will have 15 seconds per question to make your decision. Once you have made your decision, press the 'next' button to start the next question.

If you selected an answer but failed to press the “next” button within the given time, the computer program will record your answer.

If you fail to select an answer before the end of the 15 seconds, the next question will start automatically. You will not receive any points for that question.
If you have any questions, please raise your hand and the experimenter will answer you in private. When everyone is ready, Part 1 will start.

INSTRUCTION PART 2

Group formation

For this part of the experiment, you will be matched in groups of two players. Pairs of participants are formed based on your performance in Part 1. Pairs are formed according to the following rule: the participant who received the best score in Part 1 will be matched with the participant who received the second-best score in Part 1. The participant who received the third best score in Part 1 will be matched with the participant who received the fourth best score in Part 1 and so on until all the participants in the session are matched with another participant. Thus, you will be matched with a participant whose performance in Part 1 is ranked as close as possible to yours.

Task

In this Part, the task is composed of the same type of multiple choices questionnaire on general knowledge as in Part 1. The questionnaire test is composed of 30 questions. As in Part 1, these questions are the same for every participant. You will answer the questions individually. At the end of this part, your earnings will depend both on your performance and the performance of your partner. Each pair has a group account. Each of your correct answers will earn 1 point to your group account. Similarly, each of your partner's correct answer will also earn 1 point to your group account.

At the end of this part, the total points you and your partner have earned will be multiplied by a number ranging from 0.85 to 1.15, which is drawn by the computer, and then converted to Euro according to following exchange rate: 1 point = €0.67.

Group Account

The final value of your group account is determined by:
- The number of correct answers you provide in Part 2.
- The number of correct answers your partner provides in Part 2.
- The exchange rate (1 point = 0.67 euro)
- The number/multiplier the computer drew for your group.

The random multiplier for your group is determined as follows: the computer program will randomly draw a ball from an urn containing 31 balls numbered from 0.85 to 1.15. The number on your ball will define the random multiplier for your group. For example, if the computer program draws a ball labelled 1.05, the value of your group account will be equal to the total points collected by you and your partner, times 1.05. You will not know which ball was drawn by the computer program.

In summary, the final value of your group account is computed as follow:
(the number of correct answers you gave in Part 2 + the number of correct answers your partner gave in Part 2) * the number drawn by the computer for your group * 0.67

At the end of this experiment, you and your partner will have to decide on the allocation of the group account. You will receive more information about the allocation of the group account at the beginning of Part 4.

**To summarize:**
- You will be paired with a participant whose performance was close to yours in the previous part.
- Each of your correct answers will earn 1 point to your group account.
- Each of your partner’s correct answers will earn 1 point to your group account.
- The total points you and your partner have earned will be multiplied by a random number between 0.85 and 1.15, and then converted to Euro with an exchange rate of 1 point = 0.67 euro.
- At the end of the experiment, you and your partner will have to decide how to allocate the group account between the two of you.

***

If you have any questions, please raise your hand and the experimenter will answer you in private. When everyone is ready, Part 2 will start.

INSTRUCTION PART 3 (on screen)

[belief 1]
You have completed part 2. Before we continue, we would like you to estimate how many questions you think you answered correctly during Part 2.

Your estimation will be rewarded as follow:
- If your estimation is exact or deviates from your performance by only 1 answer (i.e. your estimation deviates from your actual performance by one more or one fewer correct answer), you will receive 1 euro.
- If your estimation deviates from your performance by 2 answers (i.e. your estimation deviates from your actual performance by 2 more or 2 fewer correct answers), you will receive 0.50 euro.
- If your estimation deviates from your performance by more than 2 answers, you will not receive or lose anything.

[belief 2]
On the slider below, place the percentage of chance that you performed better than your partner between 1% and 100%.

[belief 3 – part 1]

In this part of the experiment, you will see a ball drawn from one of the following urns:
- If you provided fewer correct answers that your partner, your ball will be drawn from an urn containing 15 red balls and 5 green balls. Thus, you will be more likely to see a red ball.

- If you provided more correct answers that your partner, your ball will be drawn from an urn containing 5 red balls and 15 green balls. Thus, you will be more likely to see a green ball.

- If you provided the exact same number of correct answers than your partner, your ball will be drawn from one of these two urns with a 50/50 chance. You will see a green or a red ball with the same probability.

Hence, a green ball means that you are likely to have provided more correct answers than your partner and a red ball means that you are likely to have provided fewer correct answers than your partner.

Press the “next” button when you are ready to see your ball.

[belief 3 – part 2]

The computer program randomly drew a ball. The ball is red (green), which means that you are more likely to have provided fewer (more) correct answers than your partner.

Before we continue, we would like to estimate again the likelihood that your performance was better than your partner’s.

Indicate the percentage chance that you provided more correct answers than your partner between 0% and 100%.

INSTRUCTION PART 4

In this part of the experiment, you and your partner have to agree on the allocation of the group account. The value of your group account is displayed on your screen. You can only split the group account according to the following allocation: one of you will receive 70% (share A) of the group account; the other will receive 30% (share B) of the group account.

First, you and your partner will have to indicate which share you wish to receive (either A or B). Together with this initial claim, you both can send a message to your partner explaining why you think you should receive the share that you indicated:

- If you and your partner choose different shares, you will both receive the share you claimed. Part 4 will be over.
- If you and your partner both choose the same share, you will enter into the negotiation phase.
NEGOTIATION PHASE

During the negotiation phase, you and your partner will have 3 minutes to agree on the allocation of the group account. During these 3 minutes, you will be able to negotiate with your partner via a chat box.

**Interface:**

You can see below an example of the decision screen you will see during the negotiation Stage:

![Decision Screen Example](image)

In this example, the value of the group account is 20 euros. At the top of your screen, you can see the shares labeled A and B and their respective value. Share A corresponds to 70% of the group account (14 euros in this example) and share B corresponds to 30% of the group account (6 euros in this example).

You can use the buttons A and B in the middle of your screen to choose either share A or share B. When you click on either A or B, your choice will appear under ‘your choice’ in the table. In the example below, you chose A. Therefore, A appears under ‘Your choice’.

Similarly, when your partner clicks on either A or B, her/his choice will appear under ‘The other participant’s choice’ in the table. In the example below, your partner chose A. Therefore, A appears under ‘The other participant’s choice’.
By default, the choice you made at the beginning of this part will appear under ‘your choice’ on your screen and the choice your partner made at the beginning of this part will appear under ‘the other participant’s choice’ on your screen. This information will also appear on your partner’s screen.

You can use the chat box to negotiate with your partner. Here is a screenshot of the interactive chat box:

After you typed your message in the text field, hit the “send” button to send your message to your partner.

Consequence:

- If either you or your partner choose a different share before the end of the 3 minutes, you will both receive the share that you claimed. Part 4 will be over.
- If you and your partner stick to the same share, you will be given 30 additional seconds to try to reach an agreement. HOWEVER, for each second that passes, both shares will decrease in proportion to the time elapsed, and you will no longer be able to communicate with your partner.
  - If you and your partner reach an agreement in the given time, the timer will stop. The participant who chose A will receive the money allocated to share A when the timer stopped, and the other participant will receive the money allocated to share B when the timer stopped.
  - You can change your choice at any time by hitting button A or button B at the bottom of your screen.
  - If the clock reaches 0 before you reach an agreement, you will both end up with 0 euro.

Chat and Messages:

The rules that MUST be respected when sending your messages are the following:

You are not allowed to discuss the color of the ball you received in the previous part or to give hints regarding the color of the ball.

You are forbidden to make threats, to reveal your identity, seat number or any personal information that might uncover your anonymity.

If you violate these restrictions, you will not receive any payment you made during this part of the experiment.

In summary:

- You need to indicate what share of the group account you wish to receive and send a message to your partner explaining your choice.
- If you and your partner choose differently, you will both receive the share that you claimed.
- If you and your partner both choose the same share, you will have 3 minutes to negotiate and agree on the allocation of the group account.
- If you and your partner still cannot reach an agreement by the end of these 3 minutes, you will be given 30 additional seconds to try to reach an agreement.
- However, during these 30 seconds, the amounts of each share will decrease in proportion to the time elapsed and you will no longer be able to communicate with your partner.

* * *

Please read these instructions carefully again. If you have any questions, please raise your hand and the experimenter will answer you in private. Part 4 will start when all the questions are answered.
1.3 General Knowledge Test Items

This section presents the questions of the general knowledge tests for part 1 and part 2 of the experiment. Under each question, we report the four options that were shown to the participants. The correct answer is displayed in bold.

Questions General Knowledge Test - Part 1:

1. What is the name for the process by which heat is transferred by the motion of a fluid?  
conduction / convection / radiation / dissipation

2. At the opening ceremony of every Olympic Games when the athletes parade into the stadium, what is traditionally the first nation to enter?  
France / Zimbabwe / Greece / Denmark

3. What do anthropologists study?  
human beings / coal / monkeys / minerals

4. Who, in 1831, first demonstrated that the motion of a conductor in a magnetic field generates an electric current?  
Isaac Newton / Humphrey Davy / Ernest Rutherford / Michael Faraday

5. What is the name of the engraved stone, discovered in 1799, that provided a key to deciphering the languages of ancient Egypt?  
Babel stone / Blarney stone / Rosetta stone / talking stone

6. What French military unit was established in 1831 to enable people from other countries to serve in the French Armed Forces, commanded by French officers?  
the foreign army / the foreign legion / the foreign squad / the foreign forces

7. Which of Galileo’s achievements brought him into conflict with the church, resulting in his being confined to his house for the last years of his life?  
He attempted to measure the speed of light / He invented the thermometer / He said that Copernican view of the universe was correct / He attempted to measure the weight of air

8. Which of these musical terms means the loudest?  
Mezzo forte/ Mezzo piano / Forte / Piano

9. In the Alfred Hitchcock film ‘Psycho’, where did the murder take place?  
in the bedroom / in the kitchen / in the entrance / in the shower

10. In chess, what piece is allowed to jump over other pieces?  
the bishop / the knight / the rook / the pawn

Questions General Knowledge Test - Part 2:

1. John Milton created what name for the capital of Hell in his poem ‘Paradise Lost’?  
Dystopia / Bedlam / Chaos / Pandemonium

2. Tolstoy’s book ‘War and Peace’ is set when?

Note that this is an English translation as the original experiment was conducted in French.
3. What is the name for the region of an astronomical object from which externally received light originates, which extends into a star’s surface until the gas becomes opaque? chromosphere / corona / photosphere / cretaceous

4. Which South American country extends the furthest east? Argentina / Brazil / Uruguay / Bolivia

5. Which of these territories has the northernmost capital city? Iceland / Sweden / Russia / Canada

6. What are formed from linear chains of amino acids? Proteins / Carbohydrates / Red blood cells / Vitamins

7. Which of these characters can be found in Stendhal’s book ‘The Red and The Black’? Julien Sorel / Pierre Rougon / Charles Bovary / Meursault

8. The unit of electrical resistance was named after whom? Alessandro Volta / Simon Ohm / Benjamin Franklin / Guglielmo Marconi

9. Titan is a moon of which planet? March / Uranus / Saturn / Venus

10. How many pieces are on a chessboard at the start of a game? 8 / 32 / 16 / 64

11. Which of these is the largest in area? Spain / Texas / Algeria / Afghanistan

12. Which of these types of music did not originate in the Caribbean? Zouk / Flamenco / Ska / Reggae

13. Which Scotsman took out a patent in 1876 that was the nucleus of the telephone? Alexander Fleming / Thomas Edison / George Stephenson / Alexander Bell


15. Which revered world figure celebrated his 95th birthday, in hospital, in July 2013? The Dalai Lama / Nelson Mandela / Ban Ki Moon / Pope Francis I

16. What is the closest planet to the sun? Venus / Mercury / Saturn / March

17. Who has won the most Olympic Gold medals? Paavo Nurmi, Finland / Michael Phelps, USA / Larissa Latynina, URSS / Mark Spitz, USA

18. In medicine, what do the initials BMI stand for? Implants M´écaniques Corporels / Investissment Micro-Chimiques / Institut Médicale Canadien / Indice de Masse Corporelle

19. A single flame gas burner frequently used in student science laboratories is named after whom? John Tilley / Michael Faraday / Sir Humphry Davy / Robert Bunsen
Johnny Depp / Macauley Culkin / Freddie Highmore / David Kelly

21. Conventionally, Lent, the period of the Christian calendar leading up to Easter is how long?
One week / one month / 40 days / 15 days

22. Who was the Roman god of wine and fertility?
March / Jupiter / Bacchus / Quirinus

23. Where is it believed that fireworks were invented?
China / Mexico / Egypt / Greece

24. Which of these is found in the brain?
Cuboid / thalamus / fibula / humerus

25. Which of these is in North America?
The Ozarks / the Ural / the Himalayas / the Pyrenees

26. What science features in the "Indiana Jones" film series?
Physics / archaeology / physiotherapy / astronomy

27. What does the chemical symbol Fe stand for?
Iron / gold / silver / charcoal

28. What does the "B" stand for in the acronym "FBI"?
Bureau / Baltimore / Business / Bluster

29. Seth MacFarlane is the creator of which of these TV series?
Beavis and Butthead / the Simpsons / South Park / the Griffins

30. The Richter scale measures the intensity of what?
Rain / wind / earthquakes / tornados
2. Additional Analyses

2.1 Summary Statistics

Table S2.1 displays the average number of correct answers provided in the partner phase (Part II), the proportion of females, the average age and average risk preference conditional on the signal received. As expected, participants who received a good signal performed better than participants who received a bad signal (two-tailed Mann-Whitney test: p<0.001). We do not find any significant differences in gender, age, or risk preferences.

Table S2.1 – Summary of the individual characteristics, by signal valence.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>150</td>
<td>6.19</td>
<td>16.97***</td>
<td>15.29</td>
<td>53.33%</td>
<td>22.93</td>
<td>5.74</td>
</tr>
<tr>
<td>G</td>
<td>180</td>
<td>6.26</td>
<td>18.93</td>
<td>15.91</td>
<td>53.38%</td>
<td>23.09</td>
<td>6.17</td>
</tr>
<tr>
<td>all</td>
<td>298</td>
<td>6.22</td>
<td>17.93</td>
<td>15.60</td>
<td>53.36%</td>
<td>23.01</td>
<td>5.95</td>
</tr>
</tbody>
</table>

Note: Table S2.1 displays the average number of correct answers provided in the partner phase, the proportion of females, age and risk preference by signal. Stars indicate two-sample Mann-Whitney tests, comparing participants who received a good signal and participants who received a bad signal. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table S2.2 – Summary of the individual characteristics, by combinations of signals.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td>24</td>
<td>6.08</td>
<td>18.10</td>
<td>16.58</td>
<td>24.60</td>
<td>19.27*</td>
<td>56.25%</td>
<td>22.23</td>
<td>5.88**</td>
</tr>
<tr>
<td>1G1B</td>
<td>102</td>
<td>6.32</td>
<td>18.09</td>
<td>15.25</td>
<td>24.26</td>
<td>19.50**</td>
<td>53.43%</td>
<td>23.17</td>
<td>5.79***</td>
</tr>
<tr>
<td>2G</td>
<td>23</td>
<td>5.96</td>
<td>17.94</td>
<td>16.13</td>
<td>24.23</td>
<td>12.79</td>
<td>50%</td>
<td>23.01</td>
<td>6.74</td>
</tr>
</tbody>
</table>

Note: Table S2.2 displays the average number of correct answers provided in the partner phase, the initial and the final values of the joint prize, the proportion of females, age and risk preferences by combinations of signals received at the pair level.

Table S2.2 shows the same average values by combinations of signals received at the pair level. One-way between-subject ANOVAs show no significant difference between combinations of signals in terms of performance, beliefs' about absolute performance, percentage of female and age ((F(2, 295)=0.81, F=1.14, p=0.322; F=1.56, p=0.211; F=0.18, p=0.833 and F=0.59, p=0.558, respectively). We also find no difference in terms of the initial prize to be shared at the pair level (F(2,146)=0.13, p=0.878). In contrast, pairs who received two good signals ended up with a smaller average final prize at the end of the negotiation process than pairs who received two signals of opposite valence (two-sample Mann Whitney test: p= 0.016), and a marginally smaller prize than pairs who received two bad signals (two-sample Mann Whitney test: p= 0.083). Finally, participants who received 2 good signals are on average more risk-seeking than participants who received 2 bad signals (two-sample Mann Whitney test: p=0.025) and participants who received 2 signals of opposite valence (two-sample Mann Whitney test: p=0.005).

2.2 Table S2.1 interpretations and Robustness checks
We first provide a thorough interpretation of the results from Table S2.1 from the SOM-R. Models (1) and (2) show a negative interaction effect between the posterior beliefs of participant $i$ and $j$ ($p=0.006$ and $p=0.008$, respectively), indicating that the beneficial effect of an increase in posterior belief of participant $i$ (see the coefficients of belief) decreases as the posterior belief of her partner increases. In contrast, this interaction term is not significant in the context of relative payoff as shown in models (7) and (8) ($p=1$ and $p=0.830$, respectively). The estimates from columns (9) and (10) show a positive effect of participant $i$’s belief on participant $i$’s relative payoff ($p=0.059$) and a negative effect of participant $j$’s beliefs on $i$’s relative payoff ($p=0.056$). While the level effect is not significant at the 5% level, the difference between the effect of participant $i$’s belief and participant $j$’s belief on participant $i$’s relative payoff is significant ($p<0.001$ in both models (9) and (10)). This result shows that higher relative confidence has a positive effect on the share of relative payoffs secured. Finally, the estimates from columns (11) and (12) support our previous finding that an increase in participant $i$’s relative confidence has a significant positive effect on participant $i$’s relative payoff.

We then replicate the results displayed in Figure 2 in the main text setting participant $j$’s posterior belief to 30 and 70 respectively in Figure S2.1 below. The pattern shown in Figure S2.1 is consistent with Figure 2 in the main text.

![Figure S2.1](image-url) – Linear prediction (with 95% confidence interval) of the effect of participant $i$’s belief on participant $i$’s absolute (upper panel) and relative (lower panel) payoffs when participant $j$’s belief is 30 (red line) or 70 (blue line). The estimates are from models (1) and (9) in Table 2.1, respectively.
2.3 Confidence and signals

Figure S2.2 – Distribution of the sum of prior beliefs (upper panel) and posterior beliefs (lower panel) for pairs of participants who received two bad signals (2B), pairs of participants who received two signals of opposite valence (1G1B) and pairs of participants who received two good signals (2G).

Figure S2.2 shows the distribution of the sum of prior beliefs (upper panel) and posterior beliefs (lower panel) within pairs, conditional on the combination of signals received. The vertical lines indicate the Bayesian theoretical average prior and posterior beliefs. Before receiving the signals, participants’ average belief should be roughly around 50% as they have no reason to believe that they performed better or worse than their partner due to the way we match them with their partners. Hence, the average sum of prior beliefs within pairs should be 100%. Participants are then given a binary signal that gives them information about their relative performance with a 75% accuracy. When receiving a bad signal, a Bayesian participant should update his beliefs from 50% to 25%. In contrast, a Bayesian participant should update his beliefs from 50% to 75% when receiving a good signal. Hence, the average theoretical sum of posterior beliefs should be 50% for participants who received two bad signals, 100% for participants who received two opposite signals and 150% for participants who received two good signals.

Table S2.3 – Average sum of posterior beliefs within pairs, conditional on the combination of signals received.

<table>
<thead>
<tr>
<th></th>
<th>2B</th>
<th>1G1B</th>
<th>2G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belief$_i$ + Belief$_j$ (posterior beliefs)</td>
<td>78.25***</td>
<td>103.35</td>
<td>137.43***</td>
</tr>
<tr>
<td>Nb pair</td>
<td>24</td>
<td>102</td>
<td>23</td>
</tr>
</tbody>
</table>

Note: Table S2.3 summarizes posterior beliefs at the pair level for pairs of participants who received two good signals (2G), two opposite signals (1G1B) and two bad signals (2B). Standard errors are in parentheses. Stars indicates the results of two-sample Mann-Whitney tests between pairs with opposite signals and pairs with the same signals. *** p<0.01, ** p<0.05, * p<0.10.
Table S2.3 displays the mean values of the average sum of posterior beliefs of participants $i$ and $j$ from the pair $\{i,j\}$ by combinations of signals. Results from two-sample Mann-Whitney tests show that pairs of participants who received two bad signals hold significantly lower beliefs than pairs who received one good and one bad signal ($p<0.001$). In contrast, pairs of participants who received two good signals hold significantly higher beliefs than pairs who received one good and one bad signal ($p<0.001$).

2.4 Agreement failures and delays

![Figure S2.3 – Summary statistics on the time needed to reach an agreement, by combination of signals.](image)

<table>
<thead>
<tr>
<th>Combinations of Signals</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>No agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2G</td>
<td>0%</td>
<td>26.09%</td>
<td>47.83%</td>
<td>26.09%</td>
</tr>
<tr>
<td>1G1B</td>
<td>6.86%</td>
<td>37.25%</td>
<td>44.12%</td>
<td>11.76%</td>
</tr>
<tr>
<td>2B</td>
<td>8.33%</td>
<td>41.67%</td>
<td>33.33%</td>
<td>16.67%</td>
</tr>
<tr>
<td>Obs.</td>
<td>9</td>
<td>54</td>
<td>64</td>
<td>22</td>
</tr>
</tbody>
</table>

Note: The upper panel shows the distribution of the time needed to reach an agreement for pairs of participants who received two good signals (green bars) and pairs of participants who received two opposite signals (red bars). The lower panel displays the proportion of participants who agreed in each stage of the negotiation process, the proportion of participants who failed to reach an agreement.

In the main text, we showed that as a pair of negotiators becomes more confident, the value of the joint prize at the end of the negotiation process decreases. In the pre-registration, we proposed that this is because pairs of negotiators with a greater discrepancy in beliefs are more likely to reach an agreement. Figure S2.3 displays the percentage of agreements reached in each stage of the negotiation process for pairs who received two good signals (red bars) and pairs who received two opposite signals (green bars). We find tentative evidence that pairs of participants who received two good signals are less likely to reach an agreement than pairs of participants who received two signals of opposite valence (two-tailed Mann-Whitney test: $p=0.078$).

To investigate the causal effect of confidence on the likelihood to reach an agreement, we pre-registered that we would estimate a probit regression of a dummy variable equals to 1 if the pair reached an agreement before the end of the negotiation process (and 0 otherwise), on the difference in posterior beliefs between participants.
i and j instrumented by both i’s and j’s signals. We also pre-registered that we will estimate a 2SLS regression and a Poisson regression of the stage at which an agreement is reached on the difference in posterior beliefs between participants i and j, instrumented by both i’s and j’s signals. Because the unit of observation is at the pair level, we should use the absolute difference in beliefs as the independent variable. However, participants’ signals are not significant predictors of the absolute difference between participants’ beliefs (p=0.628 for both signals). We can therefore not use these signals as instrumental variables.

We also pre-registered that we will estimate a 2SLS regression of the stage at which an agreement is reached on the difference in posterior beliefs between participants i and j, instrumented by both i’s and j’s signals. However, our data provide information on whether pairs of participants reached an agreement, as well as the stage of the negotiation process in which an agreement occurred (if any). This data structure allows us to perform survival analysis to investigate the causal effect of confidence on the rate of agreement (i.e. the frequency at which agreements are reached). A Kaplan-Meier survival estimate, which account for the sequential structure of our data, shows a lower rate of agreements for pairs of participants who received two good signals compared to pairs of participants who received two opposite signals. This difference is significant (Log-rank test for equality of survivor functions: chi²(1) = 4.20; p=value = 0.040).

### Table S2.4 – Effect of confidence on the rate at which agreements are reached.

<table>
<thead>
<tr>
<th>Dependent var:</th>
<th>Rate of agreements (t=stage)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beliefᵢ + Beliefᵢ</td>
<td>-0.006</td>
<td>-0.006</td>
<td>-0.006</td>
<td>-0.007</td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.041</td>
<td>0.087</td>
<td>0.096</td>
<td>0.094</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>-0.0116 to -0.0003</td>
<td>-0.0121 to 0.0008</td>
<td>-0.131 to 0.0001</td>
<td>-0.0142 to 0.0011</td>
<td></td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Obs.</td>
<td>149</td>
<td>149</td>
<td>149</td>
<td>149</td>
<td></td>
</tr>
<tr>
<td>Chi²</td>
<td>4.30</td>
<td>14.28</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
</tbody>
</table>

Note: Columns (1) and (2) report Cox estimations with proportional hazards of the rate of agreements on the sum of beliefs of participants i and j from the pair [i, j]. Columns (3) and (4) report the GMM coefficients of Poisson regressions of the rate of agreements of the sum of beliefs of participants i and j, instrumented by both i and j signals. Control variables include both participant i and j’s absolute performance in the partner phase, as well as both participant i and j’s gender, age and risk preferences.

We estimate Cox regressions with proportional hazard in which the dependent variable is the rate of agreement. The independent variables include the sum of beliefs of participants i and j from the pair {i,j}. Results are displayed in columns (1) and (2) of Table S2.4. To avoid endogeneity issues that could result from participants’ beliefs, we also estimate GMM Poisson regressions in which we instrument the sum of beliefs of participants i and j, by both i and j’s signals. The dependent variable is the same as in the Cox regressions. The results are displayed in columns (3) and (4). In columns (2) and (4), we control for both participant i and j’s absolute performance in the partner phase, as well as both participant i and j’s gender, age and risk preferences. Our unit of observation is one pair.

Models (1) to (4) show that for an increase of 10 percentage points in confidence at the pair level, the rate at which agreements are reached decreases by about 6 percentage points. Pairs of participants with high levels of confidence spend more time negotiating on average and are consequently less likely to reach an agreement.

---

2 Our data on agreements is censored on the right-hand side as pairs of participants who failed to reach an agreement in our sample may have reached an agreement if given more time. In addition, our data structure is also sequential: participants who reached an agreement in stage 1 can no longer access stage 2 and 3. Our pre-registered models do not account for these specificities of our data structure.

3 Note that we use the sum of beliefs as the main independent variable instead of the absolute differences in beliefs (as we pre-registered), as it both captures the level of confidence at the pair level and can be significantly predicted by signals (p<0.001 for both signals).
in the allocated time. The results are significant at the 5% level in model (1) but only at the 10% level in models (2) to (4).

2.5 Likelihood to concede

To investigate the causal effect of confidence on the likelihood to accept the small share, we estimate probit regressions of a dummy variable equals to 1 if a participant accepts the small share in the negotiation process (and 0 otherwise) on the difference in beliefs between participants $i$ and $j$ from a pair $\{i,j\}$, instrumented by the signals received by both $i$ and $j$. Marginal effects are displayed in Table S2.5. Columns (1) and (2) show the marginal effect for pairs of participants that reached an agreement in Stage 2. Columns (3) and (4) show the marginal effect for pairs that agreed in either Stage 1 or Stage 2. Columns (5) and (6) show the marginal effect for pairs that agreed in Stage 3. Columns (7) and (8) show the marginal effect for pairs that reached an agreement at any stage. Control variables include participant $i$ and $j$’s absolute performance in the partner phase, as well as participant $i$’s gender, age and risk preference. We use 1000 bootstrap replications with samples of one draw per pair to estimate the probit models.

Table S2.5 – Effect of confidence on the likelihood to switch from the large share to the small.

<table>
<thead>
<tr>
<th>Dependent var:</th>
<th>Stage 2</th>
<th>Likelihood to switch from the large share to the small in Stage 1 and 2</th>
<th>Stage 3</th>
<th>All stages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Belief$_i$−belief$_j$</td>
<td>-0.0060</td>
<td>-0.0059</td>
<td>-0.0064</td>
<td>-0.0066</td>
</tr>
<tr>
<td>p-value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>95% CI</td>
<td>-0.0063 to -0.0057 to</td>
<td>-0.0066 to -0.0077 to</td>
<td>-0.0011 to -0.0040 to</td>
<td>0.0011</td>
</tr>
<tr>
<td></td>
<td>-0.0057</td>
<td>-0.0042</td>
<td>-0.0061</td>
<td>-0.0055</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Obs.</td>
<td>108</td>
<td>108</td>
<td>126</td>
<td>126</td>
</tr>
</tbody>
</table>

Note: Table S2.5 shows the marginal effects of the difference in posterior beliefs between a participant and her partner (instrumented by the signals received by both participants) on her likelihood to accept the small share in the negotiation process. Columns (1) and (2) show the marginal effect for pairs of participants that reached an agreement in Stage 2. Columns (3) and (4) show the marginal effect for pairs that agreed in either Stage 1 or Stage 2. Columns (5) and (6) show the marginal effect for pairs that agreed in Stage 3. Columns (7) and (8) show the marginal effect for pairs that reached an agreement at any stage. Control variables include participant $i$ and $j$’s absolute performance in the partner phase, as well as participant $i$’s gender, age and risk preference. We use 1000 bootstrap replications with samples of one draw per pair to estimate the probit models.

Models (1) and (2) show that a 10 percentage points increase in relative confidence decreases the likelihood to accept the small share in Stage 2 by about 6 percentage points ($p<0.001$ in both models). This effect remains the same when including observations of pairs that reached an agreement in Stage 1 ($p<0.001$ in models (3) and (4)). In contrast, models (5) and (6) show that when the joint prize starts shrinking, the effect of relative confidence on the likelihood to concede in the negotiation disappears ($p=0.997$ and 0.282, respectively). Overall, a 10 percentage points increase in relative confidence significantly decreases the likelihood to concede by 4 percentage points ($p<0.001$ in models (7) and (8)).
2.6 Biases in Beliefs Updating

Even though economic models assume that people update their beliefs according to Bayes rules, data show that it is often not the case. Empirical evidence shows that people tend to update conservatively, by responding too little to new information. In addition, experimental evidence has shown that participants update positive and negative feedback asymmetrically. However, the results on asymmetric updating in the literature are mixed. Schwardmann and van der Weele (2019), for instance, also used an IQ-relevant task but did not find evidence of asymmetric updating in their data.

In this section, we investigate whether conservatism (i.e., placing too little weight on new information) and asymmetric updating (placing more weight on good signals than bad signals) exist in our sample. We follow Möbius et al. (2014) in running logistic regressions, which are based on a linearized version of Bayes’ formula. The model is given by:

\[
\text{logit}(\mu_{i,\text{post}}) = \delta \text{logit}(\mu_{i,\text{prior}}) + \beta_G I(s_i = G)\lambda_G + \beta_B I(s_i = B)\lambda_B + \epsilon_i
\]

With \(\text{logit}(x) = \ln(x/(1-x))\).

In our design, \(\mu_{i,\text{prior}}\) represents the prior belief (i.e. before the signal is observed) of participant \(i\) regarding the probability that his performance in the partner phase was higher than his partner’s. \(\mu_{i,\text{post}}\) is participant \(i\)’s posterior belief (i.e. after the signal is observed). \(\lambda_G = -\lambda_B\) is the log of the likelihood ratio (3 in our case). \(I(s_i = G)\) is an indicator variable that equals 1 if participant \(i\) received a good signal and 0 otherwise, and \(I(s_i = B)\) is an indicator variable that equals 1 if participant \(i\) received a bad signal, and 0 otherwise. If participants are perfect Bayesians, we should observe \(\delta, \beta_G, \beta_B = 1\). If participants exhibit conservatism, we should observe both \(\beta_G < 1\) and \(\beta_B < 1\). If participants exhibit asymmetric updating, we should observe \(\beta_G > \beta_B\).

Table S2.6 – Belief Updating.

<table>
<thead>
<tr>
<th>Dependent var:</th>
<th>Posterior beliefs (1)</th>
<th>Posterior beliefs (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\delta)</td>
<td>0.812</td>
<td>0.849</td>
</tr>
<tr>
<td>p-value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>95% CI</td>
<td>0.715 to 0.908</td>
<td>0.754 to 0.945</td>
</tr>
<tr>
<td>(\beta_G)</td>
<td>0.771</td>
<td>0.791</td>
</tr>
<tr>
<td>p-value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>95% CI</td>
<td>0.664 to 0.877</td>
<td>0.687 to 0.895</td>
</tr>
<tr>
<td>(\beta_B)</td>
<td>0.601</td>
<td>0.636</td>
</tr>
<tr>
<td>p-value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>95% CI</td>
<td>0.496 to 0.706</td>
<td>0.532 to 0.7411</td>
</tr>
<tr>
<td>Obs.</td>
<td>283</td>
<td>275</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.69</td>
<td>0.72</td>
</tr>
</tbody>
</table>

**Note:** Column (1) displays the estimates of the logistic regression of posterior beliefs on prior beliefs and the likelihood ratio of the signal received for the entire sample. Column (2) shows the same estimates when excluding participants who update in the wrong direction. H0: coefficient equals 1.

Results from Table S2.6 show that we can reject the null hypothesis that \(\delta = \beta_G = \beta_B = 1\) and participants are conservative on average. In addition, we found that \(\beta_G\) is significantly greater than \(\beta_B\) in both model (1) and

---

4 Examples include: Eil and Rao (2011); Möbius et al., (2014); Sharot et al., (2012).
(2) (tests of equality of the regression coefficients: \( p=0.026 \) and \( p=0.040 \), respectively), confirming the hypothesis that our participants exhibit asymmetric updating.

### 2.7 Message Content

In the first stage of the negotiation process, participants were allowed to write a message to explain to their partner why they chose a particular share. Because most participants claimed the large share in stage 1, this section provides a summary of the main reasons provided by participants to justify their choice of the large share. The messages were coded using dummy variables equal to 1 if the following categories were mentioned: Hardball strategy (the participant explicitly states that he will not back down from her initial claim), Merit (the participant explicitly states that he deserves the large share based on his performance at the task), Improvement (the participant mentions the fact that his performance improved from the first part to the second), Outside lab reasons (the participant uses arguments from his personal life or background to justify his choice) and Risk (the participant mentions the risk of losing everything if they fail to reach an agreement). One message can belong to several categories. Messages that did not match any of these categories were classified as "Other".

Figure S2.4 – Content of participants’ messages.

We first investigate whether there are significant differences in the essay content of participants depending on the signal they received. Figure S2.4 shows that participants who received a good signal use the hardball strategy more often than participants who received a bad signal and mention more often that their performance justifies their choice, as well as the risk of ending up empty-handed if they fail to reach an agreement (two-sample tests of proportion: \( p=0.060 \), \( p=0.006 \) and \( p<0.001 \), respectively). In addition, messages of participants who received a good signal are significantly longer on average than messages of participants who received a bad signal (Mann-Whitney rank-sum test: 42.76 vs. 30.31 words; \( p=0.035 \)).

---

5 Participants who failed to reach an agreement in the first stage were allowed to communicate with their partner via an interaction chat box in the second stage. However, we chose to restrict the analyses in this section to the messages sent in the first stage for two reasons: (i) avoid the selection issue that not all participants reached the second stage and (ii) messages were generally more detailed in the first than in the second stage due to the absence of time constraint. Transcripts of the messages exchanged in the second stage are available on request.

6 Participants who failed to reach an agreement in the first stage of the negotiation process were allowed to communicate with their partner via an interaction chat box. However, analysis of the chat content did not yield any additional findings.
participants' score during the second part of the experiment and the various messages categories reveals that participants with a higher score talk about merit more and refer less to outside-the-lab arguments.

We also investigate the relationship between the chat variables and our main variables of interest. These exploratory analyses reveal that using a hardball strategy is negatively correlated with the likelihood of reaching an agreement (Spearman correlation: r_s=0.15; p=0.008) but positively correlated with the likelihood of receiving the high share of the group account, conditional on reaching an agreement (SC: r_s=0.20; p=0.002), consistent with the findings of van Dolder et al. (2015). We do not find any significant relationship between the amount received from the negotiation process and the message variables.

To summarize, participants' confidence affected the content of their messages and, hence, their attempt to persuade others. While participants who received a good signal focused on their performance as their main arguments, participants who received a bad signal used more outside-the-lab arguments.

7 SC hereafter.