Why Join a Team?

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Abstract: We present experiments exploring why high ability workers join teams with less able co-workers when there are *no* short-term financial benefits. We distinguish between two explanations: pro-social preferences and expected long-term financial gains from teaching future teammates. Participants perform a real-effort task and decide whether to work independently or join a two-person team. Treatments vary the payment scheme (piece rate or revenue sharing), whether teammates can communicate, and the role of teaching. High ability workers are *more* willing to join teams in the absence of revenue sharing and *less* willing to join teams when they cannot communicate. When communication is possible, the choice of high ability workers to join teams is driven by expected future financial gains from teaching rather than some variety of pro-social preferences. This result has important implications for the role of adverse selection in determining the productivity of teams.

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1. Introduction: Team production and team-based compensation are ubiquitous in organizations (Bandiera *et al*., 2013; Owan, 2014).[1] The successful use of teams is considered a major component of 'high performance work organizations' (Ichniowski *et al.*, 1997; Ichniowski and Shaw, 1999). Potential benefits include synergies in problem-solving, complementarities between team members' inputs, better task coordination, knowledge transfer, and employee empowerment.[2] However, the preceding implicitly assumes that using teams and/or team-based compensation does not affect the quality of the workers employed by an organization. In reality, workers choose between jobs and can avoid teams through choice of employment. It is well-known that a significant share of incentive pay's impact on productivity is due to selection (*e.g.*, Lazear, 2000; Dohmen and Falk, 2011). By the same token, we cannot understand how team production and team-based incentives affect productivity without understanding who joins teams.

There are obvious gains to joining a team if strong complementarities are present, as the increased productivity from being in a team can offset any losses due to moral hazard or revenue sharing with lower ability individuals. But suppose workers have heterogeneous ability and perform a task with minimal complementarities between workers' efforts. Why would a high ability worker want to join a revenue sharing team? Standard economic arguments suggest they should prefer working individually for a piece rate because they are financially harmed by an incentive system that pools their output with the production of less able peers (Meidinger *et al*., 2003). Moreover, moral hazard should reduce team productivity (Alchian and Demsetz, 1972; Holmström, 1982), leading to lower earnings for team members. If myopic financial concerns drive the choice to join a revenue sharing team, only low ability individuals should be willing to join and the resulting adverse selection should harm the productivity of teams.

[1] In the U.S., a survey of Fortune 1000 companies reveals that 70% of large firms use some form of team incentives (Lawler *et al*., 2001; Lawler and Mohrman, 2003). The share of large firms with more than one fifth of their employees in self-managed teams increased from 37% to 66% between 1987 and 1996 (Lazear and Shaw, 2007). In Europe, the incidence of teamwork varies across countries, from less than 55% of the companies in the south of Europe to more than 75% in the UK (EWCS 2000/2001; European Foundation for the Improvement of Living and Working Conditions, 2007). Similar trends can be observed in academic research (Wuchty *et al*., 2007).

[2] See Section 2 for a discussion of the benefits and costs of team production and/or team incentives, including citations to the relevant literature.

Yet, contrary to the preceding arguments, the limited empirical evidence on this question indicates that high ability workers are surprisingly willing to join revenue sharing teams. Hamilton *et al*. (2003) provide a striking result. They study a garment company that switched its payment scheme from individual piece rates to team compensation. The most skilled workers are disproportionately likely to join a team voluntarily *even though team compensation often leads them to lose money*. Hamilton *et al.* suggest that "teams offer nonpecuniary benefits to workers" (p. 469), possibly due to socialization.

We present laboratory experiments designed to study why high ability individuals might join revenue sharing teams in the absence of immediate financial benefits. Laboratory experiments are a useful complement to field studies of the economics of organizations because of the high degree of control available in the lab and the ability to observe process data, specifically conversations between teammates, including attempts to teach. We design an environment where we systematically change single elements of the environment between treatments, isolating specific explanations for high ability participants joining revenue sharing teams. To accentuate adverse selection, we study an intentionally tough environment with minimal complementarities and full information about relative ability. High ability participants who join teams have no reason to expect their productivity to increase and know they are sharing revenue with a lower ability participant. Our conclusions are presumably not specific to our setting, as adverse selection is a general phenomenon that should be present in less extreme environments (*i.e*., settings with stronger complementarities and less certainty about being high ability), but we intentionally eliminate the "obvious" reason for joining a revenue sharing team.

We explore two explanations for why high ability workers might join revenue sharing teams in spite of short-term losses. The first is that high ability workers are motivated by pro-social preferences. They might join a revenue sharing team to increase their low ability peers' earnings at the cost of their own, consistent with models of other-regarding preferences (*e.g.*, Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000). High ability workers might also enjoy the opportunity to interact socially with other workers or may derive

pleasure from teaching their less able peers.[3] The second explanation is that high ability workers are motivated by long-term financial benefits. If they believe they can improve the performance of their less able teammates by teaching them, they might take a short-term financial hit due to revenue sharing in exchange for improving the long-term productivity of the team, especially if they anticipate mandatory team membership in the future. To separate these possible explanations, we study participants working on nonograms, a type of logic puzzle. Nonograms provide a challenging real-effort task where teaching is possible. Participants always solve the problems individually, eliminating any complementarities in production (*i.e.*, positive synergies from having a team solve the puzzle).

The experiment contains three stages. In Stage 1, participants attempt to solve a series of nonograms with piece rate compensation for correct solutions. Prior to Stage 2, they are matched into heterogeneous pairs by ability, as measured by Stage 1 performance, and decide whether to continue working for an individual piece rate or to join a team with their partner (*i.e.*, their potential teammate).[4] The Stage 1 performance of the partners is common knowledge, so the high ability partner (*i.e.*, the partner who did better in Stage 1) knows that their potential teammate is relatively poor at solving nonograms. Treatments, described below, vary how teams are paid and how teammates interact in Stage 2. In Stage 3, participants are forced to join a revenue sharing team with no direct interaction. Forced team membership in Stage 3 implies the existence of long-term benefits from teaching in Stage 2.

In the **Baseline** treatment, teams are paid in Stage 2 via revenue sharing. Teammates work on the puzzles individually but are paid based on the number of puzzles solved by the two teammates. Between puzzles, teammates can chat, providing an opportunity for social interaction as well as teaching. High ability participants are given hints about solving nonograms that can be passed on to their less able teammate. Partners know that hints will be available prior to choosing whether to join a team, making it transparent that teaching is possible.

[3] Beyond pure "joy of teaching," high ability workers may view teaching as an alternative means of increasing the earnings of their low ability peers.

[4] We use the term "partner(s)" to refer to pairs of participants who are *potentially* teammates and the term "teammate(s)" to refer to participants who actually join a team together.

The other treatments vary how attractive teams are relative to the **Baseline** treatment. In the **Piece Rate** treatment, teammates are paid a piece rate based on their individual output, rather than team output, eliminating the short-run financial disincentive for high ability subjects to join a team. The **No Interaction** treatment eliminates the chat between puzzles. Teaching is not possible, but a desire to increase the payoffs of their low ability peers can still motivate high ability participants to join teams. The **New Partner** treatment differs from the other ones by *not* holding partners fixed between Stages 2 and 3. High ability participants who join teams can still benefit from the joy of teaching, enjoyable social interactions, and financially helping their low ability teammate, but long-term financial gains from teaching are eliminated. Finally, high ability participants do *not* receive hints in the **No Hints** treatment, limiting the possibility of teaching and its associated benefits, pecuniary or otherwise.

A reason why a high ability participant might join a revenue sharing team involves pro-social preferences. The literature on group identity (*e.g.*, Chen and Li, 2009) suggests that these preferences are stronger when social distance is low. A potential concern with our lab setting is that social distance may be higher than in field settings. Therefore, in all five treatments we vary whether subjects participate in an ice breaker task before beginning the experiment. This manipulates social distance, checking whether our conclusions are sensitive to the social distance between potential teammates.

Turning to the results, 32% of high ability participants are willing to join teams in the **Baseline** treatment. This doubles to 71% in the **Piece Rate** treatment and falls to 10% in the **No Interaction** treatment. High ability participants apparently regard revenue sharing as a negative aspect of joining a team and put little weight on improving the earnings of their low ability peer when no interaction is possible. At 13% and 15% respectively, their willingness to join teams is also quite low in the **New Partner** and **No Hints** treatments. Neither a desire for social interaction nor joy of teaching seems to motivate high ability participants to join teams. The **Ice Breaker** condition generates 31% more conversation between partners when chat is possible, consistent with lowered social distance. However, this increase is confined to social interactions rather than teaching, and the **Ice Breaker** condition does *not* increase the willingness of high

ability participants to join teams. Overall, the data indicate that high ability participants are almost never willing to join revenue sharing teams unless there is a possible future financial benefit from teaching.

Consistent with the importance of teaching, "wanted to teach partner" is by far the most common reason given by high ability participants for joining a team. Subsequent to joining teams, high ability participants with access to the hints often try to teach their teammate by using these hints. Surprisingly, teaching does not improve the performance of low ability teammates but instead improves the high ability teammates' *own* performance. There is apparently some truth to the cliché that the best way to learn a topic is to teach it. The overall impact of team membership on earnings is low, but there is a positive relationship between the benefits of joining a team and the likelihood that high ability people join a team.

To summarize, we find little evidence that pro-social preferences motivate high ability participants to join teams. Rather, these participants are willing to join teams when they view the long-term financial gains from training their partners as outweighing any short-term losses due to revenue sharing.

Our findings have important implications for managers. The most important takeaway is the simplest: strong adverse selection occurs in all of the treatments with revenue sharing teams. Any manager considering the adoption of such teams should understand the potentially negative effect of adverse selection on the quality of their workforce. However, adverse selection into teams decreases when high ability workers can reap the gains of mutual learning. To mitigate the effects of adverse selection, the implementation of revenue sharing teams should emphasize the opportunities for mutual learning. Work environments should facilitate teaching within teams and stress stable team membership; these features can encourage high ability workers to join teams by increasing the odds that they reap the benefits of teaching.[5]

[5] There are several reasons for companies to make joining a team voluntary. High ability workers can always quit the company and go elsewhere when teamwork is introduced (Hamilton *et al.*, 2003). Also, letting employees choose whether to work in a team may reinforce social identity and cohesion, enhancing the benefits of teams. Experiments have shown the benefits of self-selection and decentralized team formation for the profits of firms employing cooperative workers (Kosfeld and von Siemens, 2009), for coordination in weak-link games (Chen, 2017), on productivity in study teams (Chen and Gong, 2018), and for online crowdsourcing teams (Blasco *et al*., 2013).

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 introduces our experimental design and Section 4 presents our theoretical predictions. Section 5 develops our results. Section 6 discusses these results and concludes.

2. Related Literature: Empirical tests of team formation and team incentives remain scarce (Lazear and Shaw, 2007; List and Rasul, 2011; Charness and Kuhn, 2011). While the empirical literature has investigated extensively the question of cooperation and free-riding in groups (see surveys by Ledyard, 1995; Chaudhuri, 2011; Villeval, 2019) and more recently the dynamics of group composition (*e.g.*, Bandiera *et al.*, 2013; Chen and Gong, 2018, in the context of teamwork; Page *et al.*, 2005; Ahn *et al.*, 2008; Charness and Yang, 2014, in the context of public good games), very few papers have explored selection into team-based compensation. The influential paper of Hamilton *et al.* (2003) studies a garment company switching from individual piece rates to a form of revenue sharing teams. They find that higher skilled employees are earlier volunteers to join teams even though this often harms their earnings. Babcock *et al.* (2015) present field experiments studying the effect of team incentives on class attendance and participation in exercise. In a follow-up treatment, subjects choose between individual and team-based compensation. They find that students overwhelmingly prefer individual to team payment (97% choose individual pay), which they attribute to subjects avoiding guilt from letting down their teammate. The weak-link structure of payoffs, rather than revenue sharing, makes participants worse off from choosing team-based compensation even if subjects have other-regarding preferences.[6] Given the high level of risk and low incentives associated with joining a team, it is unsurprising that few choose this option.[7]

[6] Specifically, we refer to distributional models like Fehr and Schmidt (1999) or Bolton and Ockenfels (2000). Holding attendance fixed, *both* teammates earn weakly less under team-based compensation.

[7] Kocher *et al.* (2006) study the choice to play a beauty contest game either individually or as part of a freely interacting team. Anticipating the superior decision-making of teams in such games, participants strongly prefer to join teams. All team members receive the full prize for winning a game, so there are no earnings losses due to revenue sharing. Several related papers that do *not* focus on the decision to join teams are worth noting. Friebel *et al.* (2017) find that team bonuses increase the efficiency of groups in a retail setting when there are task complementarities. Stressing the social dimensions of team membership, Bandiera *et al.* (2010) find that social ties lead to net productivity increases with agricultural workers, and Delfgaauw *et al.* (2019) find that groups with stronger social bonds working in the retail sector are less likely to suffer from free-riding.

Several papers explore sorting into team-based compensation due to personal characteristics. Lab experiments by Kuhn and Villeval (2015) find that woman are more willing than men to select team-based compensation over an individual piece rate in a setting without positive synergies from team production.[8] They attribute this difference to women's greater optimism about the ability level of their co-workers, emphasizing the role of beliefs (see also Dohmen and Falk, 2011, and Wozniak *et al*., 2014). An additional treatment shows that women are especially likely to join teams when team formation requires mutual agreement, which the authors demonstrate is consistent with women having greater aversion to advantageous inequity. In an online experiment involving employees and entrepreneurs, Cooper and Saral (2013) show that entrepreneurs, especially long-term entrepreneurs, have a lower preference for joining revenue sharing teams than otherwise similar business people. A lab-in-field study by Rosendahl Huber *et al*. (2016) reports quite different results, with entrepreneurs not having systematically different preferences for joining teams. There are positive synergies generated by joining a team in their setup, which leads to 90% of participants preferring to join a team, so the lack of an effect may be due to hitting a ceiling. They show the importance of risk aversion and beliefs about potential partners (see also Bäker and Mertins, 2013) for decisions to *not* join a team, but reject a systematic aversion to loss of power.

Our study has several important features that distinguish it from existing studies. (1) As noted previously, we view lab experiments as a valuable complement to field studies. To help us understand why individuals sort into revenue sharing teams, we employ the strengths of lab experiments in ways that would be difficult for a field study to replicate. In the lab, we can carefully change a single element of the environment between treatments, picking apart participants' motivations for joining teams. Our design intentionally limits positive synergies, reducing the financial incentives for high ability participants to join teams, thereby stressing the roles of long-term gains from teaching and pro-social preferences. Taking advantage of our access to choice process data, specifically dialogues between teammates, we directly observe when teaching occurs and how it affects performance. (2) Our experiment emphasizes the role of

[8] Their team-based pay is not exactly revenue sharing, as joining a team does *not* affect the partner's payoff.

teaching and interaction between teammates. In existing experimental studies, peer-to-peer teaching is extremely limited due to the nature of the task, and individuals are uncertain about the ability level of their potential teammate. In contrast, our task is teachable and participants are informed about their partner's skill level. High ability participants have reason to believe they might gain from joining a team and subsequently teaching their partner. The ability to chat between puzzles also means that we can evaluate whether a pure desire for social interaction contributes to joining a team. (3) We study the dynamic effects of team formation mechanisms by examining how the duration of the partnership (and thus, the expected return from teaching) influences the decision to team up. This highlights a dimension of joining a team that the existing literature has largely ignored.[9]

The primary contribution of our study is establishing that anticipated gains from teaching play a greater role than pro-social preferences in motivating high ability participants to join revenue sharing teams, but we also contribute to the literature on joint problem-solving. A growing experimental literature has shown that freely interacting teams typically, but not always, make better decisions and fewer judgment errors than individuals.[10] We differ from it as we focus on teaching within teams rather than joint decision-making. Teaching improves performance in our experiment, but for the teacher rather than the taught.[11]

While in theory an optimal team compensation scheme can be designed to motivate agents to help others in joint production (Itoh, 1991), empirical studies have delivered rather pessimistic conclusions, notably that profit sharing has little effect on helping behavior (*e.g.*, Drago and Garvey, 1998). However, team members may be more willing to help if this is not detrimental to their own productivity at work (Oosterhof *et al.*, 2009), as in our study where interactions take place only during the feedback stage. More generally, while the interaction between skill diversity in teams and peer learning has been recognized

[9] An exception is Gall *et al.* (2016), who present experiments studying how current productivity reacts to the anticipation that future team formation will be based on prior performance.
[10] See Cooper and Kagel (2005); Kocher and Sutter (2005); Charness *et al.* (2007); Feri *et al.* (2010); Charness *et al.* (2010); Maciejovsky *et al.* (2013); and Casari *et al.* (2016).
[11] See Kimbrough *et al.* (2017) for related experiments on peer-to-peer teaching.

(Lazear, 1999), very few economic studies have investigated this dimension (Owan, 2014).[12] Hamilton *et al*. (2003) and Hoogendoorn *et al*. (2014) show evidence that skill heterogeneity in teams increases productivity, and similar effects on team creativity have been found by Aggarwal and Woolley (2018) and Dutcher and Rodet (2018). While our study does not aim to compare diverse *vs*. homogenous teams, it complements this literature by investigating whether the possibility of teaching influences more skilled individuals to team up with less skilled peers.

3. Experimental Design and Procedures:

3.a. Task and Experimental Stages: Participants work at solving grid-based logic puzzles called *nonograms*. This is a challenging real-effort task with rules simple enough to be learned quickly. There are a number of tricks that make it easier to solve a nonogram, making it possible to teach within the context of a laboratory experiment. We use nonograms, rather than better-known puzzles such as Sudoku, to make it unlikely that participants would enter the session with previous experience.[13]

Each session has three main stages where participants attempt to solve 7x7 nonograms. Each stage contains five periods. All subjects face the same puzzle during a period, making it possible for them to discuss how to solve the puzzle when working in teams. Figure 1 presents a sample nonogram (puzzle + solution). Solving the puzzle requires determining which squares in the grid should be filled. The numbers given to the left of the rows and above the columns show the runs of filled squares in each row or column. For example, the numbers 1 and 4 appear to the left of the first row of the example. This means that the row contains a single filled square followed by a run of four consecutive filled squares, as can be seen in the solved version of the puzzle. In many cases, there are only a limited number of ways to fill in a row or column. For instance, there is only one way to fill in the fifth and seventh columns of the example. Knowing these simple rules makes it far easier to solve a nonogram.

[12] Peer training has been extensively investigated in the field of education (see Epple and Romano, 2011, and Sacerdote, 2011, for surveys).

[13] Supporting our conjecture that solving nonograms can be taught in a lab setting, several studies have shown that Sudoku puzzles are teachable (Calsamiglia *et al*., 2013; Kimbrough *et al*., 2017).

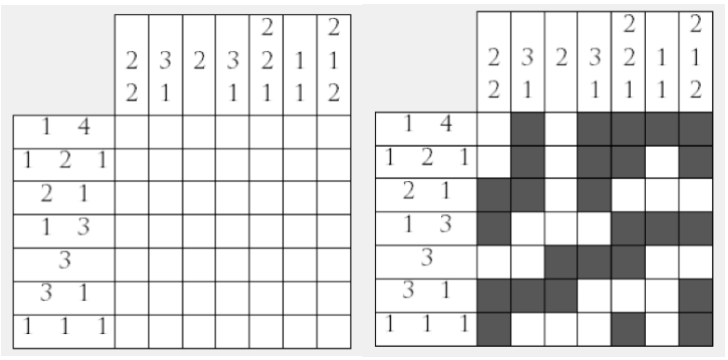

Figure 1: Example of a nonogram and its solution

Participants have 90 seconds to solve each puzzle. They can check their answer at any time by pressing an on-screen button. After each puzzle, they view a feedback screen for 60 seconds. The feedback gives their number of errors, if any, and their earnings for the round. Participants can also toggle between viewing the solution to the puzzle, their final answer to the puzzle with any incorrect cells marked by a red X, and an animated replay of how they solved the puzzle with mistakes marked as they occurred. The replay can be paused at any point, giving subjects a better opportunity to think about points where they made a mistake.

During Stage 1 (Rounds 1 – 5) of the experiment, participants are paid an individual piece rate of 1.25 Euro per correctly solved puzzle. At the end of Stage 1, each participant receives feedback on the average, median, maximum, and minimum numbers of puzzles solved in Stage 1 by all participants in the same session. Based on Stage 1 performance, participants are divided into "high ability" and "low ability" types. A participant is designated as a high ability (low ability) type if their performance was above (below) the median Stage 1 performance for that session. Any ties are broken randomly so that an equal number of subjects are assigned to each type. The labels "high ability" and "low ability" are *not* used in the experimental materials (see instructions in Online Appendix 1).

Immediately following Stage 1, participants in most sessions are informed that the top half of the participants in terms of puzzles solved in Stage 1 (*i.e.*, high ability types) will receive a "tool." This tool is a list of hints for solving the puzzles. High ability types view abbreviated hints on their screens for the remaining two stages and receive an expanded version in paper form (see Figure A1 in Online Appendix 2). Participants are also informed that participants in the bottom half of Stage 1 performance (*i.e.*, low

ability types) will receive a form with empty grids (see Figure A1 in Online Appendix 2). This facilitates the transfer of hints from one partner to the other when participating in teams and avoids identifying the type of subjects by whether they receive a form. Giving hints to the high ability types is not meant to improve their performance, but instead provides them with a natural way to teach low ability types by sharing the hints.

The task in Stage 2 is identical to Stage 1. Participants work individually to solve a series of five nonograms, with 90 seconds for each puzzle. The difference is that participants are randomly matched in pairs consisting of one high ability type and one low ability type. Prior to solving nonograms in Stage 2, partners (*i.e.*, potential teammates) choose between two options on how to interact.

Option 1 is always to work as an individual, largely as in Stage 1. Under Option 1, participants solve the puzzles individually, receive an individual piece rate of 1.25 Euro per correctly solved puzzle, and do not interact directly with their partner (*i.e.*, there is no chat). The only difference from Stage 1 is that Option 1 allows participants to receive feedback for themselves *and their partner*. Specifically, the feedback screen following each puzzle gives participants access to the solution of the puzzle, outcomes, and replays for themselves *and their partner*. The feedback phase lasts for 90 seconds rather than the 60 seconds used in Stage 1.[14]

Option 2 varies between treatments but always involves some version of joining a team. Changing Option 2 is the primary manipulation in our experimental design. Section 3.b describes the different versions of Option 2 in detail.

Partners simultaneously choose either Option 1 or Option 2. Prior to this choice, participants receive feedback showing their Stage 1 performance and classification of their performance as above or below the median performance (*i.e.*, high or low ability), as well as the Stage 1 performance and classification of their partner. The instructions remind them that participants with the hints (when available) are matched with participants without the hints. The partners are not able to communicate prior to choosing an option. If both

[14] The longer time was necessary to allow for chat in treatments with interaction. The time was expanded for both options in all treatments to maintain parallelism.

subjects choose the same option, they play the agreed upon option. If there is disagreement, a random draw determines which option is assigned to the pair.

Comparing behavior and outcomes across options and across treatments is problematic because assignment to an option is endogenous. Thus, estimated treatment effects may be biased due to selection. To make it possible to use a Heckman correction, a small fixed payment is associated with each option. These are drawn independently from a uniform distribution between 0 and 100 Euro cents and are paid only once. We use the difference between these two Heckman draws as an instrument when correcting for selection.

After Stage 2, subjects receive feedback on their own and their partner's Stage 2 performance and the average, median, maximum, and minimum Stage 2 performance across all participants in the session. Except in the **New Partner** treatment, described below in Section 3.b, participants are paired with the *same* partner for Stage 3 as in Stage 2. This is true regardless of which option the pair chose or was assigned in Stage 2. In each pair, the two partners solve five nonograms individually and equally split the piece rate of 1.25 Euro per correctly solved puzzle. There is no interaction (chat) between partners in Stage 3. The feedback phase after each period only lasts for 60 seconds since there is no chat, but otherwise remains the same as in Stage 2. Stage 3 uses the same five puzzles as Stage 2, but the rows and columns are flipped. This makes differences between Stage 2 and 3 performances a direct measure of learning between these two stages, while disguising the fact that identical puzzles are being used.[15] When choosing an option prior to Stage 2, participants know what is coming in Stage 3: revenue sharing teams with no chat and whether they will be paired with the *same* or a *different* partner in Stages 2 and 3.

After Stage 3, participants fill out a questionnaire that asks the reasons for their option choice, if they would pick the same option again, and whether they used the hints (when available). We also collect basic demographic information. Finally, to obtain a measure of reasoning ability, we give participants three

[15] Participants could not view puzzles from previous periods. We believe it is exceedingly unlikely that a participant would recognize a puzzle they had faced five periods earlier with the rows and columns flipped.

minutes to answer the three questions from Frederick's (2005) Cognitive Reflection Test (CRT) and pay them 50 Euro cents for each correct answer.

3.b. Treatments: The experimental design has a 5 x 2 structure, summarized in Table 1. The five primary treatments systematically vary Option 2 through the type of pay scheme, the ability to interact via chat between teammates, the matching for Stage 3, and the availability of hints. The five versions of Option 2 are as follows:

1) Baseline (BL): Participants solve the puzzles individually and the two teammates equally split the piece rate of 1.25 Euro per correctly solved puzzle in the pair. During the feedback phase, subjects can message with their teammate via a chat program, described below. Feedback is otherwise the same as in Option 1. Option 2 in the **BL** treatment includes all the features that might affect the willingness of high ability types to join teams in the field (relative to working individually for a piece rate): revenue sharing, the ability to teach, the possibility of social interaction, and a relatively long-term relationship. Each of the other four treatments changes a single element from the **BL** treatment, removing one of these features.

2) Piece Rate (PR): Participants solve the puzzles individually and receive an individual piece rate of 1.25 Euro per correctly solved puzzle. Relative to the **BL** treatment, the only change to Option 2 in the **PR** treatment is the elimination of revenue sharing.

3) No Interaction (NI): Participants solve the puzzles individually and the two teammates equally split the piece rate of 1.25 Euro per correctly solved puzzle in the pair. Teammates do *not* have the ability to interact via chat during the feedback phase. This is the only difference between the **BL** and **NI** treatments.

4) New Partner (NP): The only difference between the **BL** and **NP** treatments is the matching of participants in Stage 3. Recall that for all treatments other than **NP**, participants are matched with the *same* partner in Stages 2 and 3. In the **NP** treatment, participants receive a *new* partner in Stage 3, with each pair still containing one high ability type and one low ability type. At the beginning of Stage 3, participants in the **NP** treatment see information on their new partner's Stage 1 and 2 performances, classification (high or low ability), and possession of the hint. This matches what is known about Stage 3 partners in the other

treatments. Note that it is still possible to teach in the **NP** treatment; what is eliminated relative to the **BL** treatment is much of the incentive to do so.

5) No Hints (NH): The only difference between the **BL** and **NH** treatments is the information given to high ability types. High ability types do *not* receive hints in the **NH** treatment. This is intended to largely eliminate the possibility of teaching.

In all versions of Option 2, with the exception of the **NI** treatment, teammates can chat during the feedback phase via typed text messages in a chat box. Subjects are told they can share any information they like with their teammates except for their identity. This specifically includes the information in the hints (except in **NH**).

The second dimension of the 5x2 design varies social distance between subjects. Specifically, some sessions include an ice breaker activity prior to the distribution of instructions to reduce social distance (**Ice Breaker**). This is a form of interpersonal bingo, referred to as the "autograph game," which encourages the participants to interact in a way that is not related to the nonogram task. Subjects receive a sheet of paper printed with a 4x4 grid of 16 simple facts about people (*e.g.*, "Owns a cat").[16] To fill a cell, they have to find another participant from that session who fits that fact and have them sign their sheet in the cell. The goal is to have four signed cells in a row, column, or diagonal. They can only have another participant sign their sheet once and cannot sign their own sheet. The sheet is described to participants as a way to get to know each other, and there is no reward for completing it. There is no time limit. The task took 10 – 15 minutes to complete and generated a great deal of social interaction between participants.

3.c. Procedures: The experiment consists of 23 sessions with 474 subjects. All sessions were conducted at GATE-Lab (Groupe d'Analyse et de Théorie Economique) in Lyon, France. Subjects are undergraduate students from the local engineering and business schools, recruited using ORSEE software (Greiner, 2015). The experiment was programmed using z-Tree software (Fischbacher, 2007). Average earnings were 17.02

[16] There were two versions of the sheet, randomly assigned to participants in **Ice Breaker** sessions. We used two sheets to increase interactions. See Figure A2 in Online Appendix 2 for copies.

Euro and sessions lasted roughly 90 minutes. Table 1 summarizes the number of sessions and subjects for each cell of the 5x2 design, as well as the main features of each treatment. With a few exceptions, we ran two sessions in each cell of the design.[17]

Table 1: Summary of Treatments

		No Ice Breaker	Ice Breaker	Revenue Sharing	Chat	Same Partner	Hints
Baseline (**BL**)	# Sessions	3	2	X	X	X	X
	# Subjects	64	48				
Piece Rate (**PR**)	# Sessions	2	2	–	X	X	X
	# Subjects	42	46				
No Interaction (**NI**)	# Sessions	3	2	X	–	X	X
	# Subjects	58	42				
New Partner (**NP**)	# Sessions	3	2	X	X	–	X
	# Subjects	50	42				
No Hints (**NH**)	# Sessions	2	2	X	X	X	–
	# Subjects	34	48				

4. Theory and Hypotheses: This section develops a simple theory of choosing between Options 1 and 2 and then presents natural hypotheses about treatment effects drawn from the theory.

4.a. A Simple Theory: Let $S_i^t(\tau)$ be the number of puzzles solved by a participant of type $i \in \{\text{H}, \text{L}\}$ in Stage t as a function of whether teaching has occurred ($\tau = 1$) or not ($\tau = 0$). We make the following simplifying assumptions about production and teaching.

- The number of puzzles solved is a random variable.[18]

[17] There was one **BL** session where the post-experimental questionnaire failed to run. For this session we are missing CRT scores and the questionnaire about the choice of option. In regressions that include a control for the CRT score, the value for data from this session is set equal to the average by type. This session is not included in the analysis of reasons for choosing Option 2. In one of the **NI** sessions, the program ran incorrectly for two of the puzzles in Stage 2. The analysis of performance in Stages 2 and 3 drops the data from this session. Replacement sessions were run for both of the sessions where we had problems with the program. We also have an extra session in the **NP** treatment. This was a pure mistake and does not reflect any problem with the first two sessions in this cell.

[18] This assumes that effort plays no role, which is a simplifying assumption designed to match our experimental set-up. We purposefully eliminated any outside options (*i.e.*, access to internet, mobile phones, other paid tasks), so the opportunity cost of working on the puzzles was essentially zero.

- High ability types teach low ability types when they can chat and the high ability type has received the hints. Otherwise, teaching does not occur.
- Teaching improves productivity (*i.e.*, the ability to solve puzzles) for low ability types $\left(S_L^t(1) > S_L^t(0)\right)$ and has no effect on high ability types $\left(S_H^t(1) = S_H^t(0)\right)$.
- Teaching takes place across the course of Stage 2 and has a persistent effect, implying that the effect of teaching is larger in Stage 3 than Stage 2: $S_L^3(1) - S_L^3(0) \geq S_L^2(1) - S_L^2(0)$.

The utility for a participant of type $i \in \{\mathrm{H}, \mathrm{L}\}$ in Stage t is given by **(1)**, which incorporates a simple form of other-regarding preferences. The first two terms of **(1)** are a weighted average of the participant's monetary payoff π_i^t and their partner's monetary payoff π_j^t, where α is the weight that they put on their own payoff. Define $\theta_i^t(\tau)$ as the non-pecuniary benefits (if positive) or costs (if negative) of teaching for a participant of type $i \in \{\mathrm{H}, \mathrm{L}\}$ in Stage t. This term does not represent the monetary benefits of teaching due to changes in productivity, but instead captures psychological factors such as "joy of teaching" for high ability types. The non-pecuniary benefits (or costs) of teaching accrue in Stage 2 when teaching actually occurs. Let μ_i^t represent the benefits of social interaction (*i.e.*, interactions that do *not* involve teaching) for a participant of type $i \in \{\mathrm{H}, \mathrm{L}\}$ in Stage t. Social interaction occurs in Stage 2 if chat is available.

$$U_i^t\left(\pi_i^t, \pi_j^t\right) = \alpha\pi_i^t + (1-\alpha)\pi_j^t + \theta_i^t(\tau) + \mu_i^t \qquad \textbf{(1)}$$

We make the following assumptions about the utility function of participants.

- Participants put more weight on their own payoff than their partner's payoff: $1 \geq \alpha \geq ½$.
- For high ability types, $\theta_H^2(1) \geq 0$; teaching is pleasurable and involves minimal effort.
- For low ability types, $\theta_L^2(1) = 0$; being taught is neither costly nor pleasurable.
- Interacting with a partner is inherently enjoyable: $\mu_i^t \geq 0$.

Participants select the option that maximizes the sum of their expected utilities for Stages 2 and 3 plus an error term capturing the effect of the Heckman draws. A participant's choice should be independent of their beliefs about their partner's choice. If their partner's choice is the same as their preferred option, they

are certain to get their preferred option by choosing it. If their partner's choice is not their preferred option, they have a 50% chance of getting their preferred option by choosing it rather than a 0% chance.

The predictions of the model depend on the nature of Option 2. We first consider the **NI** treatment where neither teaching nor social interactions take place.

(1) NI: Expected utility in Stage 3 is identical for both options given that the pay scheme is the same for both options and neither teaching nor social interactions are possible. Therefore, the choice between options reduces to a comparison of expected utilities in Stage 2. Option 2 is chosen if the following inequality holds, where p is the piece rate, E is the expected value, and ε is an error term capturing the Heckman draws.[19]

$$(\alpha - 0.5)p\left(ES_j^2(0) - ES_i^2(0)\right) + \varepsilon > 0 \qquad \textbf{(2)}$$

The term on the left gives the gains or losses from revenue sharing in Stage 2. This is positive for a low ability type and negative for a high ability type. Ignoring the error term, low ability types will always choose Option 2 (revenue sharing teams) and high ability types will always choose Option 1 (piece rate). For subsequent treatments, we only consider predicted choices for high ability types. Ignoring the error term, low ability types are always predicted to choose Option 2.

$$0.5p\left(ES_L^2(1) - ES_L^2(0)\right) + 0.5p\left(ES_L^3(1) - ES_L^3(0)\right) + \theta_H^2(1) + \mu_H^2 + \varepsilon > (\alpha - 0.5)p\left(ES_H^2(0) - ES_L^2(0)\right) \qquad \textbf{(3)}$$

(2) BL: High ability types will choose Option 2 if the positive effect of teaching, both in terms of gains from increased productivity of the low ability type and non-pecuniary benefits, plus the benefit from social interaction is large enough to offset the expected loss of payoffs in Stage 2 due to revenue sharing. The inequality shown in **(3)** captures this tradeoff. The first two terms on the left side are monetary gains from teaching the low ability type. The third and fourth terms are non-pecuniary benefits of teaching and utility from social interaction. The right side, transcribed from **(2)**, is the expected loss from Stage 2 revenue

[19] The two expected utilities are compared by the following inequality: $\alpha \mathrm{pES}_\mathrm{i}^2(0) + (1-\alpha)\mathrm{pES}_\mathrm{j}^2(0) < \alpha\left(0.5\mathrm{pES}_\mathrm{i}^2(0) + 0.5\mathrm{pES}_\mathrm{j}^2(0)\right) + (1-\alpha)\left(0.5\mathrm{pES}_\mathrm{i}^2(0) + 0.5\mathrm{pES}_\mathrm{j}^2(0)\right) + \varepsilon$. This simplifies to (2). The preceding is slightly simplified, as ε is actually the sum of two Heckman draws weighted by α.

sharing. Option 2 is chosen if **(3)** holds (*i.e.*, the gains from teaching and social interaction outweigh the losses due to revenue sharing).

(3) PR: There is no revenue sharing in the **PR** treatment. Thus, the right side of **(3)** equals zero. Since the left side of **(3)** is strictly positive, ignoring the error term, high ability types always choose Option 2.

(4) NP: The high ability types do *not* reap any monetary benefits from Stage 2 teaching in Stage 3 of the **NP** treatment. The second term of **(3)** is therefore dropped, yielding **(4)**. The benefits of teaching are lower in the **NP** treatment than in the **BL** treatment and high ability types are less likely to choose Option 2.

$$0.5p\left(ES_L^2(1) - ES_L^2(0)\right) + \theta_H^2(1) + \mu_H^2 + \varepsilon > (\alpha - 0.5)p\left(ES_H^2(0) - ES_L^2(0)\right) \quad \textbf{(4)}$$

(5) NH: Without hints, teaching is no longer possible and **(4)** becomes **(5)**. Given that any benefits of teaching are eliminated, high ability types are less likely to choose Option 2 in the **NH** treatment than in the **NP** treatment. They may still choose Option 2 if the benefits of social interaction are sufficiently high.

$$\mu_H^2 + \varepsilon > (\alpha - 0.5)p\left(ES_H^2(0) - ES_L^2(0)\right) \quad \textbf{(5)}$$

4.b. Hypotheses: The hypotheses below follow directly from the theory but are also quite intuitive in nature. Inequality **(3)** leads directly to H1. Intuitively, revenue sharing increases the earnings of low ability types and decreases the earnings of high ability types. In the absence of teaching or social interactions, this makes Option 2 more attractive for low ability types. Indeed, the only reason we ever expect low ability types to choose Option 1 and high ability types to choose Option 2 in the **NI** treatment is random noise.

H1: *Low ability types will choose Option 2 more often than high ability types in the **NI** treatment.*

The remaining hypotheses compare the behavior of high ability types across treatments. The main takeaway from **(3)** is that Option 2 becomes more attractive with interaction because of the benefits of teaching and social interaction. These benefits are maximized in the **BL** treatment.

H2: *High ability types will choose Option 2 more often in the **BL** treatment than in the **NI** treatment.*

Comparing Option 2 in the **PR** and **BL** treatments, the only difference is that high ability types do not bear costs from revenue sharing in Stage 2 of the **PR** treatment. This leads to **H3**. The only reason for a high ability type to choose Option 1 in the **PR** treatment is random noise.

H3: *High ability types will choose Option 2 more often in the **PR** treatment than in the **BL** treatment.*

Reducing the benefits of teaching by rematching partners in the **NP** treatment or largely eliminating the benefits by removing hints, as captured in **(4)** and **(5)** respectively, should make Option 2 less attractive for high ability types.

H4: *High ability types will choose Option 2 less often in the **NP** treatment than in the **BL** treatment.*

H5: *High ability types will choose Option 2 less often in the **NH** treatment than in the **NP** treatment.*

The **Ice Breaker** condition should have an effect through two channels. First, the model includes benefits from social interaction (μ_i^t). Presumably, participants enjoy interaction more when social distance between them is lower, which is the intended effect of the **Ice Breaker** condition. Therefore, the **Ice Breaker** condition should lead to more high ability types choosing Option 2 in the treatments with Stage 2 chat (**BL**, **PR**, **NP**, and **NH**). Along similar lines, we have thus far assumed that α is fixed, but lower social distance produced by the **Ice Breaker** condition may lower α (putting relatively more weight on the partner's payoff). This implies a more frequent choice of Option 2 by high ability types in the revenue sharing treatments (**BL**, **NI**, **NP**, and **NH**). High ability types should be more willing to sacrifice earnings to help low ability types when they feel closer to them.

Combining the preceding observations yields **H6**.

H6: *High ability types will choose Option 2 more often with the **Ice Breaker** condition in all five primary treatments (**BL**, **PR**, **NI**, **NP**, and **NH**).*

Our formal model and hypotheses focus on the question that this experiment is designed to address: when do individuals, particularly high ability individuals, join teams? The model assumes that teaching achieves its intended goal of improving performance by low ability types and that high ability types

correctly anticipate its positive effects. We state no formal hypotheses about these issues, but will examine them carefully in the results section.[20]

5. Results: We first analyze the willingness of high ability types to join a team. Then, we examine whether high ability types try to teach their teammate and whether this improves their performance. Finally, we study the earnings from joining a team.

5.a. Treatment Effects on Choice of Option 2: To discuss whether differences between treatments are statistically significant, we first consider non-parametric tests. Unless otherwise noted, the reported test statistic is a Pearson's χ^2 test. We treat each subject as an independent observation since participants do not work in teams prior to choosing an option. We later supplement the results of the χ^2 tests with regression analysis using probit models, but this has little effect on our conclusions.

Table 2: Choice to Join a Team (Option 2)

Treatment	# Obs per Type	Low Ability	High Ability
BL	56	57.1% (base for χ^2)	32.1% (base for χ^2)
PR	44	65.9%	70.5%***
NI	50	62.0%	10.0%***
NP	46	60.9%	13.0%**
NH	41	65.9%	14.6%**

Notes: Stars indicate the level of significance of Pearson's $\chi 2$ tests comparing each treatment, by ability type, with the **BL** treatment. There are no stars in the row for the **BL** treatment, since this serves as the reference for the test. Three (***), two (**), and one (*) stars indicate significance at the 1%, 5%, and 10% level, respectively.

Table 2 summarizes how frequently subjects choose Option 2.[21] The data are broken down by ability (low or high) and primary treatment (**BL**, **PR**, **NI**, **NP**, and **NH**). **H1** predicts that low ability types will be more likely to choose Option 2 than high ability types in the **NI** treatment. The data support this prediction

[20] The model mimics our experimental environment by including no complementarities in team production. The model could be easily extended to allow for complementarities, but doing so would not affect our hypotheses.
[21] Note that this is *not* the same as being assigned Option 2. If two partners choose different options, it is randomly determined whether they are assigned Option 1 or Option 2.

and the difference is significant ($p < 0.001$).[22] However, the **NI** treatment illustrates a seemingly odd feature of our data. Across the four treatments where Option 2 involves revenue sharing, 38% of low ability types opt for the piece rate over revenue sharing and there are no significant differences across treatments. Even for low ability types who solve *zero* problems in Stage 1, and hence would benefit the most from revenue sharing, 26% still choose the piece rate. The apparent oddity of many low ability types eschewing revenue sharing reflects the powerful impact of the Heckman draws on option choice. For low ability types who pick the piece rate, the Heckman draw averages 0.31 Euro more for Option 1 than for Option 2, and 84% have a larger Heckman draw for Option 1. Despite this feature, the fraction of low ability types choosing Option 2 remains higher than the fraction of high ability types making such a choice. This leads to our first observation.

*Observation 1: When interaction through chat is not available in Stage 2 (**NI**), fewer high ability types choose revenue sharing than low ability types. This is consistent with **H1**.*

A primary reason we are interested in who joins teams is that voluntary team membership could lead to adverse selection. Indeed, there is strong adverse selection in the **NI** treatment. Average Stage 1 performance for participants who choose Option 2 is 1.83 puzzles solved *vs*. 2.95 puzzles solved for *all* participants in the **NI** treatment. Strong adverse selection is also observed in the other three treatments (**BL**, **NP**, and **NH**) with revenue sharing teams, as can be seen from the relatively low percentage of high ability types who choose Option 2. Only in the **PR** treatment is adverse selection not present.

We now get to the central question of our paper: why would high ability participants join a team? In the **NI** treatment, revenue sharing harms high ability types and they have no opportunity to teach or socially interact. The only reason for a high ability type to join a team is a desire to improve the payoff of their low ability partner. This apparently matters little since few high ability types choose Option 2. In contrast, the **BL** treatment allows teaching, with the associated financial and non-pecuniary benefits, as well as social interaction. Reflecting these improved incentives, the rate of choosing Option 2 by high ability types rises

[22] For this test, an observation is a pair. We use a Wilcoxon signed-rank test to test whether the difference between the choices of the high and low ability types equals zero.

significantly from 10% in the **NI** treatment to 32% in the **BL** treatment ($p = 0.006$). This leads to our second observation.

*Observation 2: Consistent with **H2**, high ability types choose Option 2 more often in the **BL** treatment than in the **NI** treatment.*

The only difference between the **PR** and **BL** treatments is that high ability types do *not* bear a revenue sharing cost from choosing Option 2. This should maximize the attractiveness of Option 2, and indeed the rate of choosing Option 2 by high ability types more than doubles relative to the **BL** treatment (71% *vs.* 32%; $p < 0.001$).[23] This leads to our third observation.

*Observation 3: Consistent with **H3**, high ability types choose Option 2 more often in the **PR** treatment than in the **BL** treatment.*

The theory provides three possible reasons why high ability types choose Option 2 more frequently in the **BL** treatment than in the **NI** treatment: financial gains from teaching, non-pecuniary benefits from teaching, and benefits from social interactions. To separate these explanations, the **NP** treatment reduces the financial benefits from teaching while the **NH** treatment makes teaching much more difficult. In both cases, the proportion of high ability types choosing Option 2 is more than halved relative to the **BL** treatment (13% and 15% relative to 32%). Both differences are significant ($p = 0.024$ for **NP** and $p = 0.048$ for **NH**). The likelihood of choosing Option 2 is not significantly different for either of these treatments than in **NI** ($p = 0.640$ for **NP** and $p = 0.500$ for **NH**), nor is the difference between the **NP** and **NH** treatments significant ($p = 0.830$). Our fourth observation follows.

*Observation 4: Consistent with **H4**, high ability types choose Option 2 less often in the **NP** treatment than in the **BL** treatment. Option 2 is also chosen less often in the **NH** treatment than in the **BL** treatment, but, contrary to **H5**, there is no difference between the **NP** and **NH** treatments.*

Turning to the second dimension of our design, **H6** predicts that choice of Option 2 will be more frequent in the **Ice Breaker** condition for all five primary treatments. Aggregating across all five primary treatments, choice of Option 2 by high ability types is slightly less frequent in the **Ice Breaker** condition

[23] Every high ability type who chooses Option 1 in **PR** has a higher Heckman draw for Option 1 than Option 2.

(31% vs. 25%), but the difference is not significant (p = 0.314).[24] Looking at the individual treatments, differences are generally small and not significant.[25] One possible interpretation of the negligible effect of the **Ice Breaker** condition could be that it is too weak an intervention to affect the social distance between participants. Previewing results presented in Section 5.b, this seems unlikely since the **Ice Breaker** condition has powerful effects on the quantity of communication when subjects can chat. The **Ice Breaker** condition affects how teammates interact but does not affect their desire to join a team. This suggests that the financial implications of joining a team weigh more heavily in subjects' minds than any social aspects. Observation 5 summarizes our finding from the **Ice Breaker** condition.

*Observation 5: Contrary to **H6**, high ability types are not more likely to choose Option 2 in the **Ice Breaker** condition.*

Thus far, we have used simple χ^2 tests to determine the significance of differences between treatments. However, participants differ on a number of dimensions that could affect their choice, such as their own and partner's ability, the Heckman draws, and their personal characteristics. Table 3 reports the results of probit models that control for these factors. The dependent variable in all regressions is a dummy for the choice of Option 2. Probit models are used because the dependent variable is binary. The independent variables of greatest interest are the treatment dummies, with the **BL** treatment as the omitted category. All regressions include controls for the participant's own number of puzzles solved in Stage 1, their partner's number of puzzles solved in Stage 1, and the difference between the two Heckman draws divided by 10 (a positive difference means that Option 2 provides a higher guaranteed payoff than Option 1). Models 2L and 2H include additional controls for personal characteristics: CRT score, age, and gender. These are not significant except for age in Model 2L. We report marginal effects rather than raw parameter estimates and *robust* standard errors in parentheses.[26]

[24] Low ability types are slightly more likely to choose Option 2 in the **Ice Breaker** condition (61% vs. 63%), but this difference is not significant (p = 0.807).

[25] The one exception is the **NH** treatment, where the choice of Option 2 is significantly *lower* in the **Ice Breaker** condition (p = 0.024). This is opposite the predicted direction, but given that there is no reason to expect an effect to emerge in **NH** but not the other treatments, we are inclined to view it as a statistical anomaly.

[26] It is arguable whether individuals are independent observations in the **Ice Breaker** condition since subjects interacted prior to the beginning of the experiment. We treat individuals as independent observations since they did

Table 3: Probit Regressions on Choice of Option 2

	Low Ability Types		High Ability Types	
	Model 1L	Model 2L	Model 1H	Model 2H
Own, Stage 1 Correct	-0.077***	-0.083***	-0.052	-0.039
	(0.029)	(0.031)	(0.041)	(0.043)
Partner, Stage 1 Correct	0.010	0.015	0.016	0.019
	(0.048)	(0.049)	(0.025)	(0.023)
Difference, Heckman Draws	0.052***	0.052***	0.011	0.012
	(0.009)	(0.009)	(0.007)	(0.007)
PR	0.129	0.134	0.387***	0.394***
	(0.098)	(0.099)	(0.097)	(0.098)
NI	0.041	0.045	-0.209***	-0.205***
	(0.098)	(0.099)	(0.078)	(0.078)
NP	0.047	0.054	-0.193**	-0.194**
	(0.102)	(0.103)	(0.079)	(0.079)
NH	0.015	0.042	-0.154*	-0.153*
	(0.109)	(0.111)	(0.082)	(0.083)
Ice Breaker	-0.015	0.003	-0.107*	-0.101
	(0.069)	(0.069)	(0.062)	(0.064)
CRT Score		0.029		-0.013
		(0.033)		(0.033)
Age		0.010*		0.009
		(0.006)		(0.012)
Female		-0.024		-0.082
		(0.069)		(0.066)
Log-likelihood	-131.32	-129.92	-109.26	-108.24
AIC	280.64	283.85	236.52	240.47
BIC	311.85	325.46	267.73	282.09

Notes: All regressions are based on 237 observations. Marginal effects are reported. Robust standard errors are reported in parentheses. Three, two, and one stars indicate significance at the 1%, 5%, and 10% levels, respectively.

The estimated treatment effects are largely consistent with our previous observations. Looking at either Model 1L or 2L, there are no significant treatment effects for low ability types.[27] The negative and significant estimates for **NI** in Models 1H and 2H support **H2**, and the positive and significant estimates for **PR** support **H3**. The negative and significant parameter estimates for **NP** in Models 1H and 2H support **H4.** In line with Observation 4, the estimates for **NH** are negative and significant in Models 1H and 2H,

not know about the rest of the experiment when the ice breaker took place, but an alternative version of Table 3 with the standard errors corrected for clustering can be found in Online Appendix 3 (Table A1), with a cluster defined as an individual in sessions without the ice breaker and the session in sessions with the ice breaker. The effect of correcting for clustering on the qualitative results is negligible.

[27] This would not change if we use a different treatment as the omitted category, since **BL** is the treatment where the fewest low ability types choose Option 2.

but, contrary to **H5,** the estimates for **NP** and **NH** are not significantly different**.** The one detail that differs from our previous observations is the marginally significant *negative* effect of the **Ice Breaker** condition in Model 1H, contrary to the *positive* effect predicted in **H6**.

The pattern of estimates differs for low and high ability types. Unlike high ability types, low ability types respond strongly to their own performance in Stage 1, as well as the difference between their Heckman draws.[28] There are no significant treatment effects for low ability types. Our primary focus is on the choices of high ability types, but these results suggest that the decisions of low ability types are driven by a different set of concerns, particularly a desire to gain a higher payoff via the Heckman draw (even if the increase is marginal).

Summarizing our results thus far, the treatment effects suggest that the primary reason a sizable fraction of high ability types are willing to join teams in the **BL** treatment is the expected financial gain from teaching, especially from long-term improvement in their partners' productivity. If pro-social preferences play an important role, we should observe more high ability types choosing Option 2 in the **NI**, **NP**, and **NH** treatments. High ability types' answers to the post-experimental survey provide additional support for these conclusions. Subjects were given multiple possible reasons for their choice of options and could check as many reasons as they wanted. "Wanted to teach [my] partner" is the most common reason high ability types give for choosing Option 2 (see Table A2 in Online Appendix 3 for detailed statistics). This is especially true when teaching is most likely to have financial benefits (**BL** and **PR**); teaching is more than twice as common (74% *vs.* 33%) than the second most frequent reason high ability types give for choosing Option 2 ("…thought communication would motivate [my] partner"). In contrast, when teaching is less likely to have financial benefits (**NI**, **NP** and **NH**), the reasons given for choosing Option 2 are mainly in line with some sort of pro-social preferences. About two-thirds of high ability types who choose Option 2 in these three treatments indicate they "… didn't want to let [their] partner down by not sharing revenue" and almost half

[28] Comparing the strength of responses to the Heckman draws, one standard deviation increase in the difference between the Heckman draws is estimated to increase the probability of a high ability type choosing Option 2 by 5.3% as opposed to 23.4% for a low ability type (based on Models 2L and 2H). The estimated effect of the difference in Heckman draws fall just below weak statistical significance ($p = 0.103$) in Model 2H.

state that they "… prefer to work with others." Neither of these reasons is common in the **BL** and **PR** treatments.

The point is *not* that the treatments affect the preferences of high ability types. Presumably, some high ability types with strong pro-social preferences are *always* willing to join a team regardless of the treatment. However, there appears to be a different and larger group of individuals who only join a team when it is likely to be financially beneficial. In the treatments where Option 2 is most likely to be financially beneficial due to teaching, most joiners identify teaching as their motivation.

*Observation 6: The ability to teach low ability types is the most common reason given by high ability types that choose Option 2, especially in treatments where teaching is likely to be financially beneficial (**BL** and **PR**).*

5.b. Do They Teach and Does It Help? High ability types frequently identify teaching their partner as a reason for choosing Option 2, but it need not follow that they actually provide help on how to solve the puzzles (*i.e.*, try to teach) or that this improves their teammate's performance. This subsection addresses these two issues. To measure whether high ability types tried to teach, two research assistants coded independently all the messages sent between teammates assigned Option 2 in **BL**, **PR**, **NP**, and **NH**. Details of how this coding exercise was conducted, including a full listing of the coding categories and frequencies for each category by treatment, are provided in Online Appendix 4. Here, we summarize the main results.

The theory is agnostic about how often help ought to be provided. There is no explicit cost to communication and no reason *not* to teach given that it is always potentially useful. Nonetheless, if there are effort costs involved with teaching, the pattern of when help is provided makes sense intuitively. Comparing the four treatments with chat, **BL** and **PR** make teaching relatively easy due to the hints and relatively beneficial due to the fixed partnership. High ability types send more messages per period in these two treatments (4.02 *vs*. 2.73) and give help with solving the puzzles more frequently (1.62 *vs*. 0.80). High ability types joining teams in these two treatments say they want to teach, and they do so.

The **Ice Breaker** condition does not affect the willingness of high ability types to choose Option 2, but it does increase the frequency of communication between teammates. The average total number of

messages sent per period across the four treatments with chat increases in the **Ice Breaker** condition (7.33 *vs.* 5.60). The increase is similar for high (3.92 *vs.* 3.19) and low (3.42 *vs.* 2.41) ability types. The frequency of teaching by high ability types drops slightly in the **Ice Breaker** condition (1.72 *vs.* 1.49 in **BL** and **PR**). The **Ice Breaker** condition makes teammates more social, but has little effect on the amount of teaching.

Simple non-parametric tests are not useful for checking whether the differences reported above are significant, since treatment effects are confounded with selection into Option 2. We therefore run regressions with a Heckman correction for selection, using the Heckman draws and the random tie-breaker as instruments (see Online Appendix 4 for details and Table A4 for results). These regressions support our previous statements. High ability types send significantly more messages per period[29] and teach significantly more frequently[30] in the **BL** and **PR** treatments compared to the **NP** and **NH** treatments. The **Ice Breaker** condition significantly increases messages per period for both types,[31] but has no significant effect on the provision of help by high ability types.[32] This analysis is summarized by Observation 7.

*Observation 7: High ability types communicate and teach more in the **BL** and **PR** treatments than in the **NP** and **NH** treatments. The **Ice Breaker** condition increases communication by both types, but does not affect the amount of teaching.*

High ability types often try to teach low ability types, but it does not follow that teaching improves the performance of low ability types. A pre-condition for teaching to be effective is that the task is learnable. Comparing performance over time is tricky, as the difficulty of the puzzles varies widely. We solved this problem by using the same puzzles in Stages 2 and 3 and switching the rows and columns in Stage 3. Given this switch, the five period gap between repetitions, and the lack of any way to view previous puzzles, it is highly unlikely that participants noticed the repetition. Comparing performance in Stages 2 and 3 gives a clean test of whether learning is possible. The average number of puzzles solved increases significantly from 2.96 in Stage 2 to 3.36 in Stage 3 ($p < 0.0001$),[33] with similar increases for both types (2.59 *vs.* 3.06 for low

[29] The coefficient is 1.292 with a robust standard error of 0.339 ($p < 0.001$).
[30] The coefficient is 0.742 with a robust standard error of 0.221 ($p < 0.001$).
[31] For low (high) ability types, the coefficient is 1.123 (0.969) with a robust standard error of 0.301 (0.350). In both cases, $p < 0.01$.
[32] The coefficient is -0.045 with a robust standard error of 0.224 ($p = 0.842$).
[33] This is based on a Wilcoxon matched-pairs signed-ranks test with each session treated as a single observation.

ability types; 3.33 *vs.* 3.65 for high ability types). Subjects learn between Stages 2 and 3.

The regressions shown in Table 4 examine the effect of messages relating to teaching on the number of puzzles solved in Stage 3. We correct for selection using a Heckman correction as described previously. The dependent variable is the number of puzzles solved in Stage 3, after teaching has occurred. We focus on three independent variables: the total number of Stage 2 codings for the high ability type giving help, the low ability type asking for help, and the high ability type specifically referring to the hints. These three categories directly relate to high ability types teaching low ability types. The regressions include additional unreported controls for the treatment, own ability, and teammate's ability.

Table 4: Effects of Teaching on Performance

	Low Ability	High Ability
High Ability Type Gives Help	-0.129*** (0.041)	-0.029 (0.040)
Low Ability Type Requests Help	-0.037 (0.057)	-0.046 (0.052)
High Ability Type Refers to Hints	0.111*** (0.042)	0.088** (0.043)
Log-likelihood	-227.31	-233.19
AIC	486.62	498.39
BIC	538.32	550.08

Notes: These regressions are based on 187 observations, including 107 participants assigned to Option 2, and use a Heckman correction. Robust standard errors are reported in parentheses. Three, two, and one stars indicate significance at the 1%, 5%, and 10% level, respectively.

For low ability types, a powerful negative effect from high ability types giving help is offset by the positive effect of referring to the hints. Receiving help never improves the performance of low ability types but is harmful only if the hints are not used. We conjecture that this reflects two countervailing forces: help based on the hints contains useful information but is also a distraction for the low ability types. In contrast, providing help by using the hints improves the performance of the high ability types in Stage 3. Presumably using the hints to teach makes high ability types think about them more carefully than would occur otherwise, making high ability types better at solving the puzzles.[34]

The data suggest that high ability types primarily join teams because they anticipate benefits from

[34] This is consistent with studies showing that teaching has cognitive benefits (*e.g.*, Bargh and Schul, 1980; Eskreis-Winkler *et al.*, 2019).

teaching low ability types. They are correct to anticipate these benefits, but in a presumably unanticipated fashion. Rather than improving the performance of their teammate, teaching primarily improves the performance of the high ability type doing the teaching.

Observation 8: Being taught does not improve the performance of low ability types and can harm performance when teaching is not based on the hints. Teaching improves the performance of high ability types, especially when the hints are used.

5.c. Does Choosing Option 2 Improve Payoffs? If high ability types choose Option 2 because of higher anticipated *financial* benefits, there should be a positive relationship between the likelihood of choosing Option 2 and the expected payoff. Table 5 reports average total payoffs across Stages 2 and 3 (excluding the Heckman draws) for high ability types, broken down by whether the individual is assigned to Option 1 or 2.[35] Because it is endogenous which participants are assigned to Option 2, we complement the raw data shown in Table 5 with IV regressions. For each treatment, these regress total payoffs on assignment to Option 2, using the Heckman draws and random tie-breaker as instruments for assignment to Option 2, and controlling for ability and the **Ice Breaker** condition. The estimated difference (*i.e.*, the estimated effect of being assigned to Option 2) and *p*-values reported in Table 5 come from these regressions.

Table 5: Average Payoffs for High Ability Types in Stages 2 and 3

	Option 1	Option 2	Estimated Difference (*p*-value)
BL	8.33	7.61	0.342 (0.480)
PR	7.97	8.77	1.447 (0.022)
NI	8.73	7.68	-0.702 (0.421)
NP	8.77	7.83	-1.453 (0.081)
NH	8.09	7.83	-0.408 (0.496)

The pattern of estimated gains lines up well with the frequency of choosing Option 2: high ability types are most likely to choose Option 2 in **PR**, the treatment with the highest estimated (and only significant) gain from choosing Option 2. The only other treatment that generates a substantial number of high ability types choosing Option 2 is **BL**, the only other treatment where the estimated benefit is positive.

[35] Recall that the option a participant is assigned need not be the same as the option that they choose. Table A5 in Online Appendix 5 reports analogous data and regression results for the number of puzzles solved in Stages 2 and 3.

The three treatments where a negligible number of high ability types choose Option 2 (**NI**, **NP**, and **NH**) all have negative estimated benefits from choosing Option 2. The pattern of choices correlates well with expected financial benefits from choosing Option 2, leading to our final observation.

Observation 9: For high ability types, there is a positive relationship between the estimated benefits of being assigned Option 2 and the likelihood of choosing Option 2.

We conclude the results section with a brief discussion of a critical question from a manager's point of view: Is it beneficial to adopt revenue sharing? To answer this question, we compare the total number of puzzles solved across Stages 2 and 3 for teams assigned to Option 2 in the **BL** and **PR** treatments. These two treatments differ solely in how participants are paid for Stage 2. Given that the total pay per puzzle solved is the same in both treatments, productivity directly determines a manager's profits. Total output rises from 12.29 in **BL** to 13.38 in **PR** (Wilcoxon rank-sum test, $p = 0.078$). Although it is not our aim to study the relative merit of revenue sharing, the somewhat lower productivity in **BL** illustrates the potential downside of revenue sharing.

6. Discussion and Conclusion: Team production and team incentives are pervasive within organizations. While there are good reasons for this, such as taking advantage of complementarities in production and encouraging mutual monitoring, adverse selection is likely to limit the advantages of teams. Better knowledge of the selection process into teams is a necessary ingredient for understanding when teams will be beneficial and how to design team incentives. Relatively little research exists which examines workers' willingness to join workplace teams. Laboratory experiments, like those presented in this study, are a useful complement to field studies because the controlled environment makes it possible to isolate specific reasons for joining a team.

We study a stark environment that eliminates the most obvious reasons that a high ability worker would want to join a revenue sharing team, such as complementarities in production. Nevertheless, we find that roughly a third of high ability workers are willing to join revenue sharing teams in our **Baseline** treatment. Additional treatments indicate that this willingness of high ability types to join revenue sharing teams stems

from expected financial benefits rather than pro-social preferences, specifically long-term gains from teaching their low ability partners. A post-experimental survey supports this conclusion as wanting to teach their partner is the most common reason given by high ability types for joining a team. When assigned to a team, high ability types frequently provide help to their low ability partner as long as it is straightforward to do so by using the hints. Teaching improves productivity, but it does so in an unexpected fashion. Rather than increasing the performance of low ability types, teaching by using the hints helps the performance of high ability types. It is possible that, to be more effective, the teaching of less able performers requires more time than permitted in the context of a short experiment.

With the obvious caveat that our conclusions are based on a specific environment, our results have important potential implications for managers. They suggest that managers should be aware of the negative effects of adverse selection when considering adoption of revenue sharing teams since their organizations may become less attractive to the ablest workers. On a brighter note, however, our findings also suggest that these effects can be mitigated by designing a work environment that makes it possible for high ability types to successfully teach their less skilled co-workers and subsequently reap the rewards of teaching. This includes the provision of tools that facilitate teaching and clear incentives that encourage the transmission of knowledge that is key for the development of collective intelligence in organizations.

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ONLINE APPENDIX 1. INSTRUCTIONS

[***All treatments***]

Thank you for participating in today's experiment. I will read the instructions that explain the content of today's experiment and the interfaces. Feel free to ask questions if you have any.

You will receive 4 Euros for showing up on time for the experiment. In addition, you will be able to earn money during the experiment and in a final questionnaire. At the end of the experiment, you will be called individually to receive your earnings in private. The amount you will have earned will be paid in cash. If you have any questions, press the red button on the side of your desk and we will answer your questions in private.

[***Ice Breaker*** *condition*] PRELIMINARY PART

The purpose of this preliminary part is to help you get to know other participants in today's session. You have received a form to complete that includes a set of individual characteristics.

Your objective is to complete a line OR a column OR a diagonal of four cells with the signatures of other participants in the session that correspond to the characteristics described by these cells.

A person can sign only one cell on a card and you cannot sign your own form. There is no need to put your name on the cells or on the form.

We will therefore ask you to get up and go into the reception room to exchange your information and fill your form.

Once you have completed four cells (on a line, or a column or a diagonal) with four signatures, please return your form to an experimenter and return to your seat.

--- *After subjects come back to their seats*----

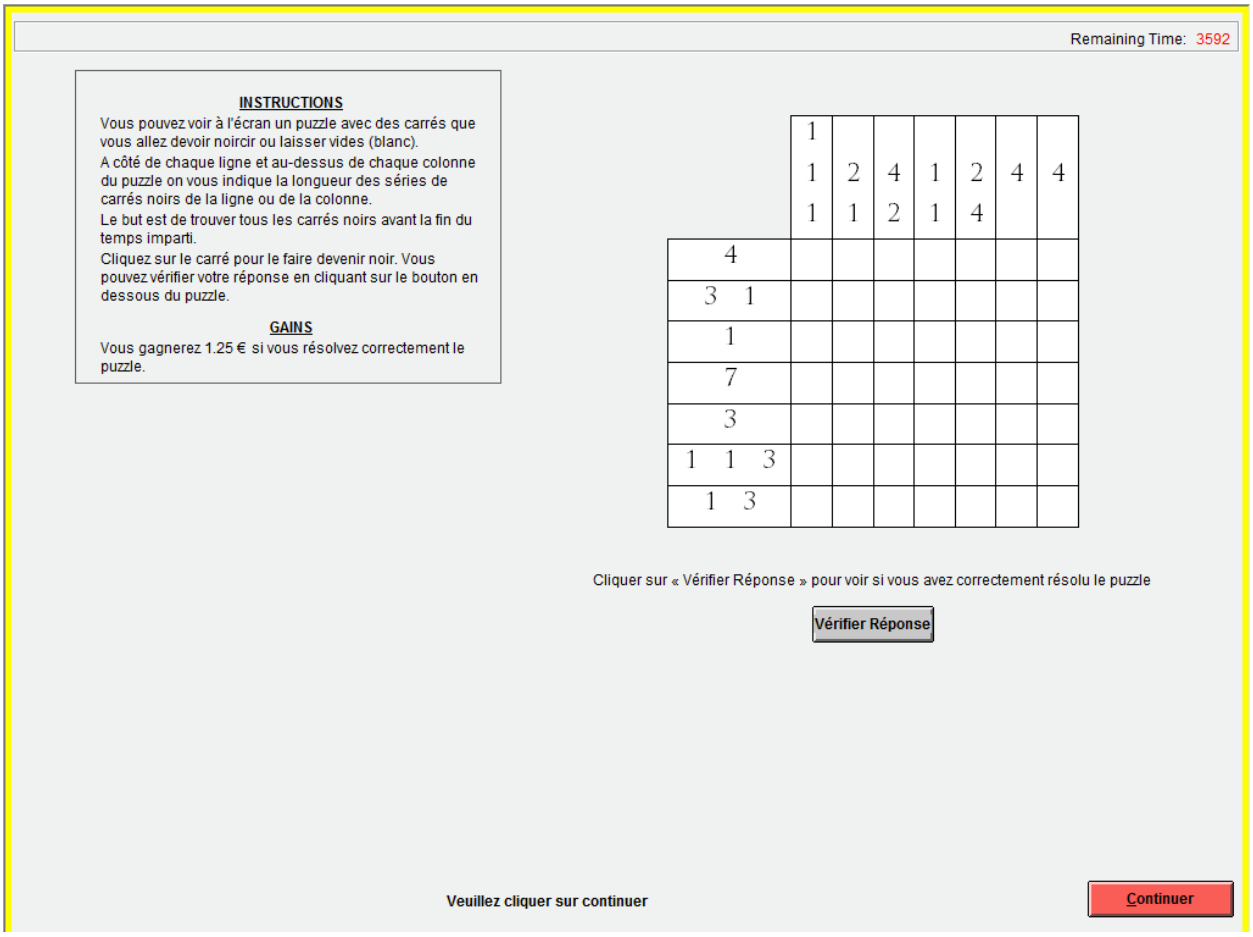
Please press the Continue button and follow the instructions on your screen.

[***All treatments***]

PART 1

This part consists of 5 periods, each consisting of a puzzle to solve. In each period you will have 90 seconds to solve the puzzle. If you solve the puzzle correctly before the time runs out, you will earn €1.25. Otherwise, you will earn €0 for this period.

Press Continue to see an example of a puzzle to solve.



You should now have on your screen the interface of the puzzle that you will see throughout the experiment. The type of puzzle you will have to solve is called a nonogram. The rules are simple. You can see a grid of squares that you have to blacken or leave blank. Click on the square to blacken it and click again to make it white again.

Beside each line of the puzzle, we indicate the length of each series of black squares in this line, in order. Above each column we indicate the length of each series of black squares in that column, in order. The goal is to find and mark all the black squares.

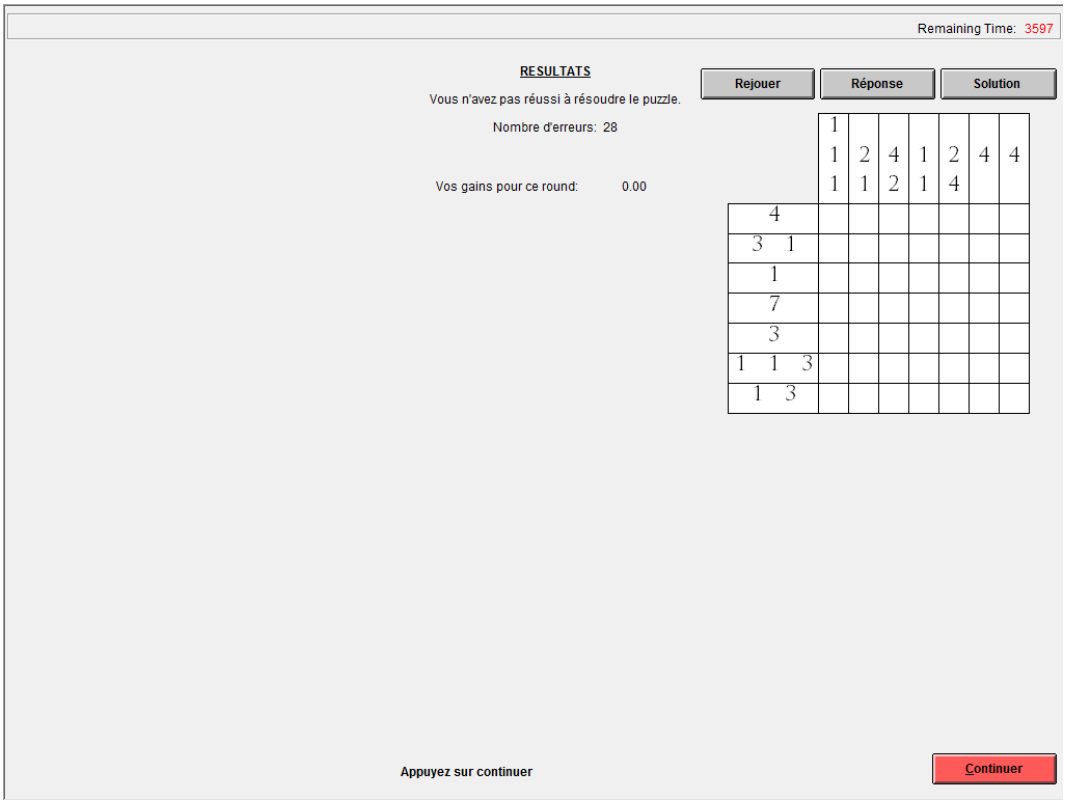
For example, next to the first line of the grid, you can see the number 4. This means that there is a series of 4 black squares, with no spaces between them, in the first line.

In some cases, there may be more than one number. For example, in the second line, you can see the numbers 3 and 1. This means that in this line, there is a series of exactly 3 black squares, followed by one or more white squares, followed by a single black square.

Columns work the same way as rows. In the first column you can see the numbers 1, 1 and 1, which means that there are three isolated black squares in this column and there must be at least one white square between each black square.

While you are trying to solve the puzzle, you can press the "Check Answer" button at any time to see if you have successfully solved the puzzle. You can continue making changes in the grid once you have pressed this button. You will have 90 seconds in total to solve this puzzle and at the end of the allotted time, you will be automatically redirected to the results screen.

Please press Continue to be redirected to an example of the results screen.



You can now see an example of a results screen to which you will be redirected at the end of each period. In the middle of the screen you can see if you have solved the puzzle or not. If you have not succeeded, you are informed of your number of errors. As this is a training period, there are no earnings, but if this period had been paid, you would have earned €1.25 if you had solved the puzzle before time had run out.

Above the grid on the right, you can choose "Replay," which allows you to review the markings you have made in the previous screen. Errors are indicated by a red X. You can also pause this by pressing the red "Pause" button that will appear after you press Replay.

You can also see your answer without reviewing all the markings made by pressing the "Answer" button or simply look at the solution by pressing the "Solution" button. Please press the Solution button. You can now see that the grid is immediately updated with the solution of the puzzle. You now have 3 minutes to look at this solution.

---
3 minutes

SUMMARY OF PART 1

• This part consists of 5 periods of the game you just saw.
• In each period you will have 90 seconds to solve a puzzle.
• At the end of the allotted time, you will automatically see the results screen where you can review your answers for 60 seconds before starting the next period.

At the end of the 5 periods, you will receive summary information about the number of puzzles you have solved and the results of the other participants.

We will now start the paid periods. Please press Continue to start the first period.

[***BL treatment*** *(revenue sharing, interactions, hints and same partner in the last part)*]

PART 2

You have now completed Part 1. Please press Continue.

Before you start the second part, you should know that participants in the session ranked in the top half in terms of the number of solved puzzles (*i.e.*, those who solved more puzzles than the median) have been selected to receive hints.

If you have been selected, you should now see the hints displayed in the center of your screen. These hints will always be accessible until the end. If you have not been selected, this is indicated at the top of your screen.

We have also distributed a sheet of paper to each of you. If you have received hints, the sheet gives a more detailed description of these hints. If you have not received hints, the sheet has only an empty frame that you can complete.

Please do not press Continue until you have received your sheet of paper. Take time to look at this sheet. Then press Continue to see the new rules for this part.

---
3 minutes

A new part is about to start with different rules. In this part you will participate in the same game for another 5 periods, but in this part you will be paired with a partner. You will keep the same partner for the 5 periods.

If you received hints, your partner did not receive them and conversely, if you did not receive hints, your partner received them. At the bottom of the screen, you can see information about your performance and that of your partner in the first part.

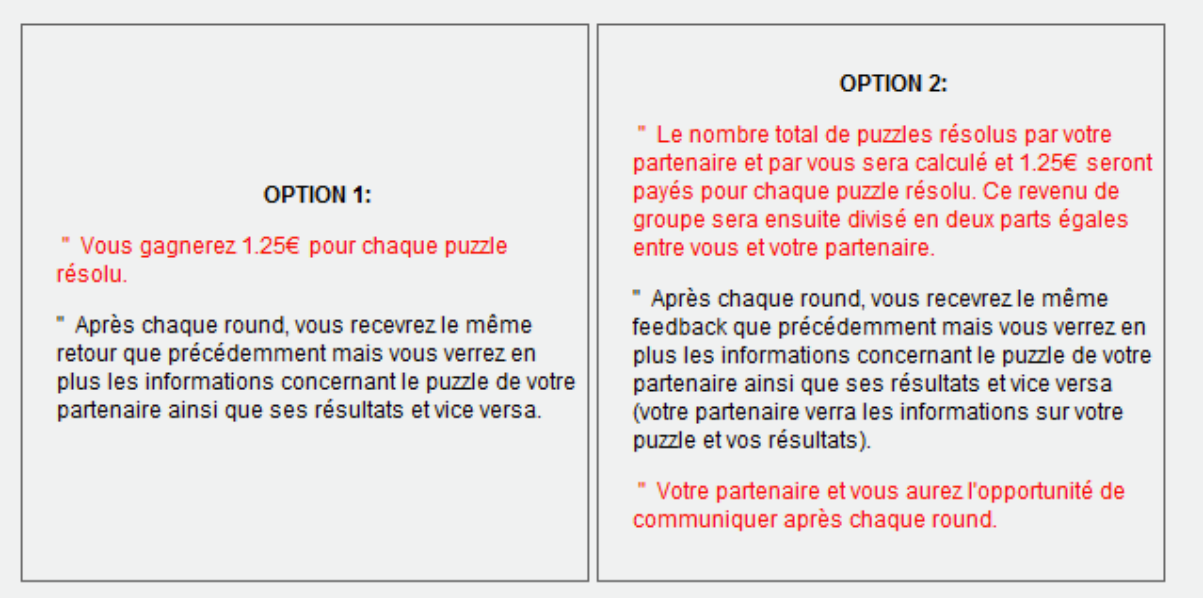
Please press Continue.

In each period, you and your partner will have to solve the same puzzle individually, but you have the choice on how to participate in this part with your partner. You have to choose one of the following two options that will apply to the 5 periods. The differences between the options are highlighted in red on your screen.

Option 1 appears in the box on the left of your screen.

With option 1:
• You will earn €1.25 for each puzzle solved by yourself.
• At the end of each period, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.

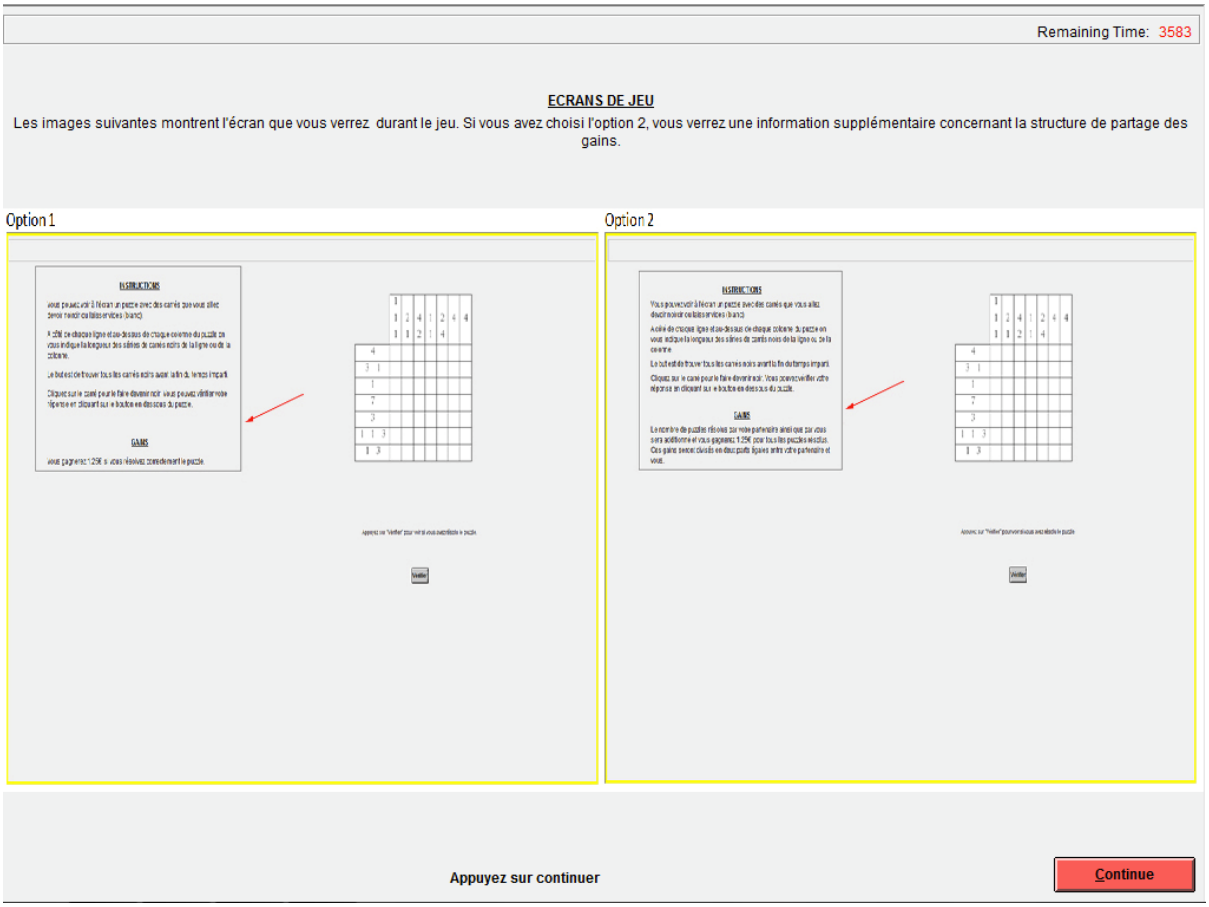
Option 2 appears in the box on the right of your screen.



With option 2:
• The total number of puzzles solved by your partner and by you will be calculated and €1.25 will be paid for each puzzle solved. This group income will then be divided in two equal parts between you and your partner.
• After each round, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.
• Your partner and you will have the opportunity to communicate after each round.

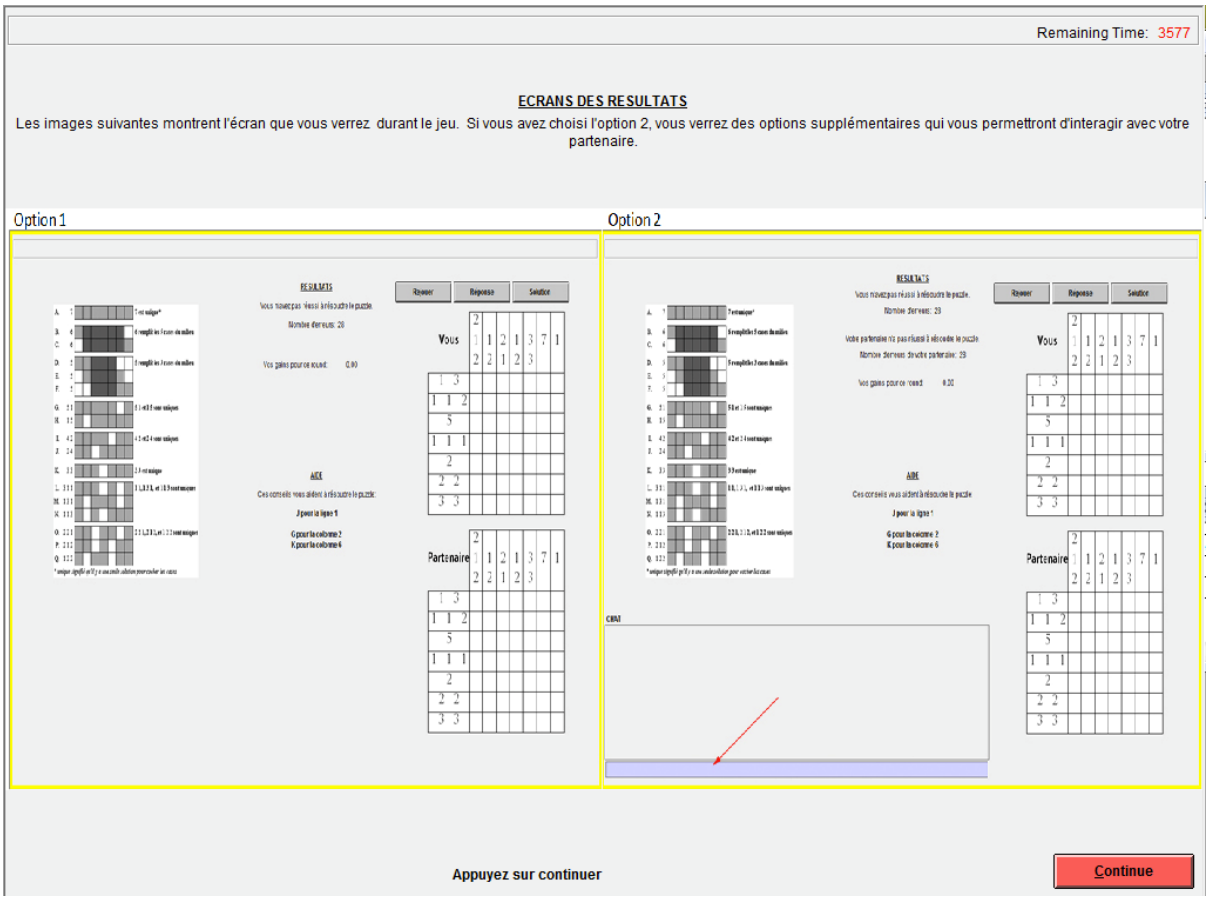
Note that the difference between these options is that you will be able to communicate with your partner and you will share your earnings with your partner in option 2, but not in option 1. Any interaction is done on the results screen only, and not while you are trying to solve the puzzle.

Please press Continue to see how the interface changes depending on the option.



The figures show a side-by-side comparison of the screens for both options. Whichever option you have chosen, the screen is identical and it is identical to previous periods. The red arrows point to the difference in the earnings but everything else is similar. You and your partner must solve the puzzle individually. If you have been selected to receive hints, you will have access to them at the bottom left of your screen.

Please press Continue.



You should now see a side-by-side comparison of the results screens for both options.

In each option, you will receive information about your partner's puzzle in the middle of the screen, below your own results.

The main differences between option 1 and option 2 have been highlighted with red arrows. For option 1, the results screen is the same as in the previous part. For option 2, the screen allows you to interact with your partner.

- First, you will also have access to your partner's grid on the right. So, when you choose Replay or Solution or Answer, it will update with your answer at the top and your partner's answer at the bottom. This is also valid for your partner who will also have access to your results.

- Second, you can freely exchange messages with your partner by writing inside the chat box at the bottom of your screen.

You can use the chat box to talk about what you want, including the information on the hints if you received them. The only restriction is that you must not try to identify yourself or use offensive language.

Please press Continue.

You are informed that **in the third and last part,** you will remain matched with the same partner as in this second part. But while in this second part you have the choice of the mode of participation with your partner, in the last part:

- you will not have the choice of the option

- you and your partner will no longer have the opportunity to interact

- and €1.25 will be paid **for the sum of the puzzles solved by your partner and by you. This group income will then be divided in two equal parts between you and your partner.**

Please press Continue.

[***PR treatment*** *(piece rate, interactions, hints and same partner in the last part)*]

PART 2

You have now completed Part 1. Please press Continue.

Before you start the second part, you should know that participants in the session ranked in the top half in terms of the number of solved puzzles (*i.e*., those who solved more puzzles than the median) have been selected to receive hints.

If you have been selected, you should now see the hints displayed in the center of your screen. These hints will always be accessible until the end. If you have not been selected, this is indicated at the top of your screen.

We have also distributed a sheet of paper to each of you. If you have received hints, the sheet gives a more detailed description of these hints. If you have not received hints, the sheet has only an empty frame that you can complete.

Please do not press Continue until you have received your sheet of paper. Take time to look at this sheet. Then press Continue to see the new rules for this part.

---
3 minutes

A new part is about to start with different rules. In this part you will participate in the same game for another 5 periods, but in this part you will be paired with a partner. You will keep the same partner for the 5 periods.

If you received hints, your partner did not receive them and conversely, if you did not receive hints, your partner received them. At the bottom of the screen, you can see information about your performance and that of your partner in the first part.

Please press Continue.

In each period, you and your partner will have to solve the same puzzle individually, but you have the choice on how to participate in this part with your partner. You have to choose one of the following two options that will apply to the 5 periods. The differences between the options are highlighted in red on your screen.

Option 1 appears in the box on the left of your screen.

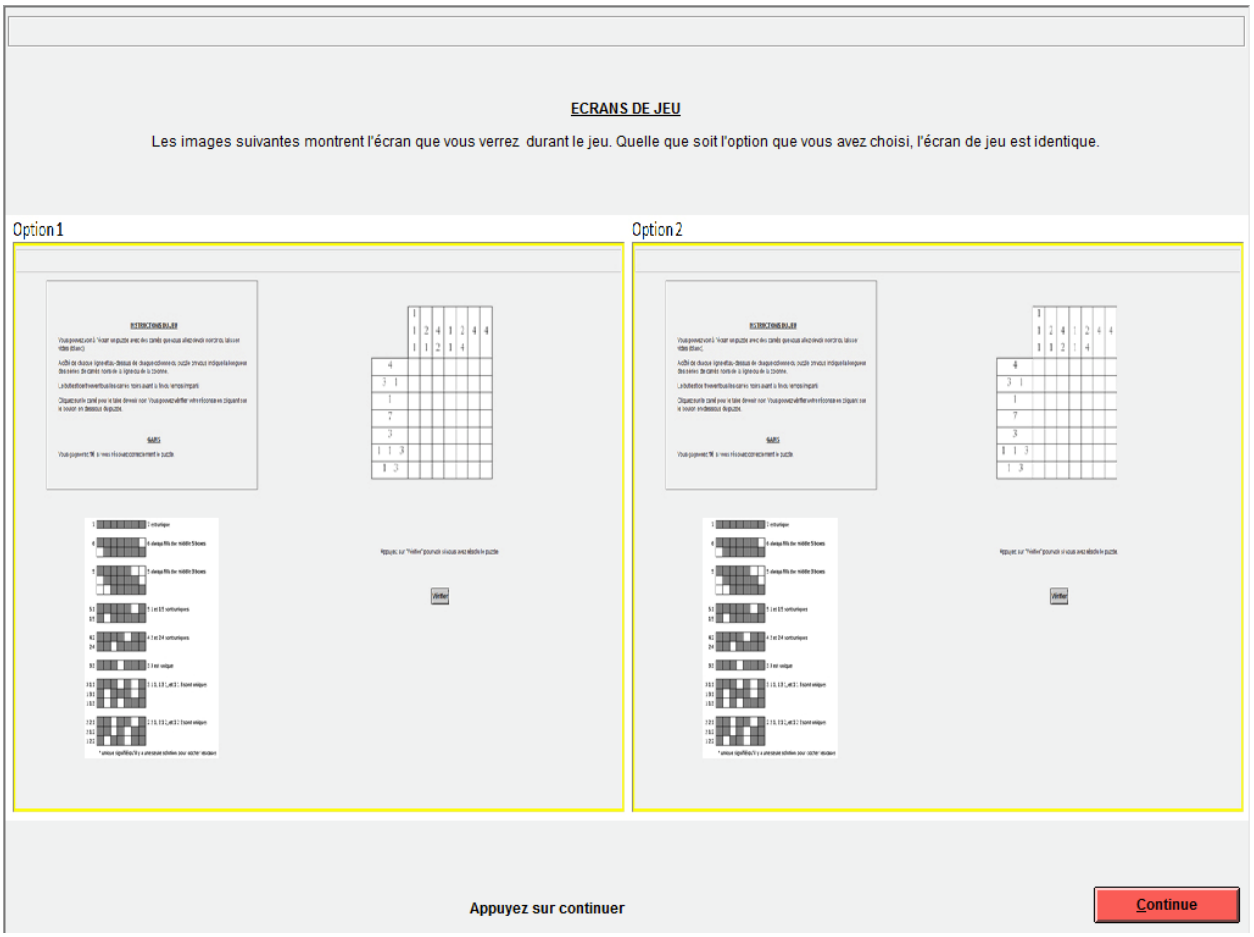
With option 1:
• You will earn €1.25 for each puzzle solved by yourself.
• At the end of each period, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.

Option 2 appears in the box on the right of your screen.

With option 2:
• You will earn €1.25 for each puzzle solved by yourself.
• At the end of each period, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.
• Your partner and you will have the opportunity to communicate after each round.

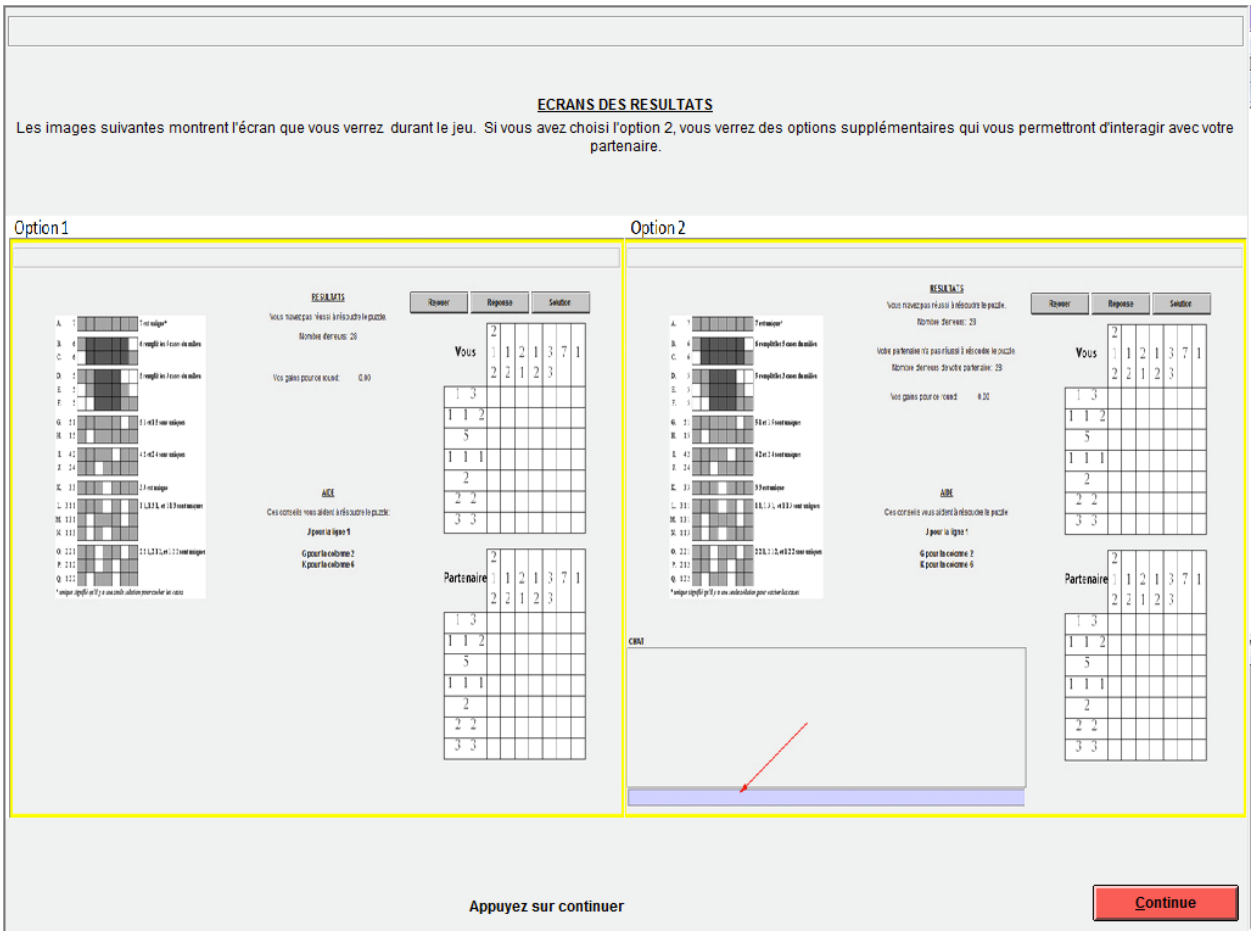
Note that the difference between these options is that you will be able to communicate with your partner in option 2, but not in option 1. Any interaction is done on the results screen only, and not while you are trying to solve the puzzle.

Please press Continue to see how the interface changes depending on the option.



The figures show a side-by-side comparison of the screens for both options. Whichever option you have chosen, the screen is identical and it is identical to previous periods. You and your partner have to solve the puzzle individually. If you have been selected to receive hints, you will have access to them at the bottom left of your screen.

Please press Continue.



You should now see a side-by-side comparison of the results screens for both options.

In each option, you will receive information about your partner's puzzle in the middle of the screen, below your own results.

The main differences between option 1 and option 2 have been highlighted with red arrows. For option 1, the results screen is the same as in the previous part. For option 2, the screen allows you to interact with your partner.

- First, you will also have access to your partner's grid on the right. So, when you choose Replay or Solution or Answer, it will update with your answer at the top and your partner's answer at the bottom. This is also valid for your partner who will also have access to your results.

- Second, you can freely exchange messages with your partner by writing inside the chat box at the bottom of your screen.

You can use the chat box to talk about what you want, including the information on the hints if you received them. The only restriction is that you must not try to identify yourself or use offensive language.

Please press Continue.

You are informed that **in the third and last part,** you will remain matched with the same partner as in this second part. But while in this second part you have the choice of the mode of participation with your partner, in the last part:

- you will not have the choice of the option

- you and your partner will no longer have the opportunity to interact

- and €1.25 will be paid **for the sum of the puzzles solved by your partner and by you. This group income will then be divided in two equal parts between you and your partner.**

Please press Continue.

[***NI treatment*** *(revenue sharing, no interactions, hints and same partner in the last part)*]

PART 2

You have now completed Part 1. Please press Continue.

Before you start the second part, you should know that participants in the session ranked in the top half in terms of the number of solved puzzles (*i.e.*, those who solved more puzzles than the median) have been selected to receive hints.

If you have been selected, you should now see the hints displayed in the center of your screen. These hints will always be accessible until the end. If you have not been selected, this is indicated at the top of your screen.

We have also distributed a sheet of paper to each of you. If you have received hints, the sheet gives a more detailed description of these hints. If you have not received hints, the sheet has only an empty frame that you can complete.

Please do not press Continue until you have received your sheet of paper. Take time to look at this sheet. Then press Continue to see the new rules for this part.

---
3 minutes

A new part is about to start with different rules. In this part you will participate in the same game for another 5 periods, but in this part you will be paired with a partner. You will keep the same partner for the 5 periods.

If you received hints, your partner did not receive them and conversely, if you did not receive hints, your partner received them. At the bottom of the screen, you can see information about your performance and that of your partner in the first part.

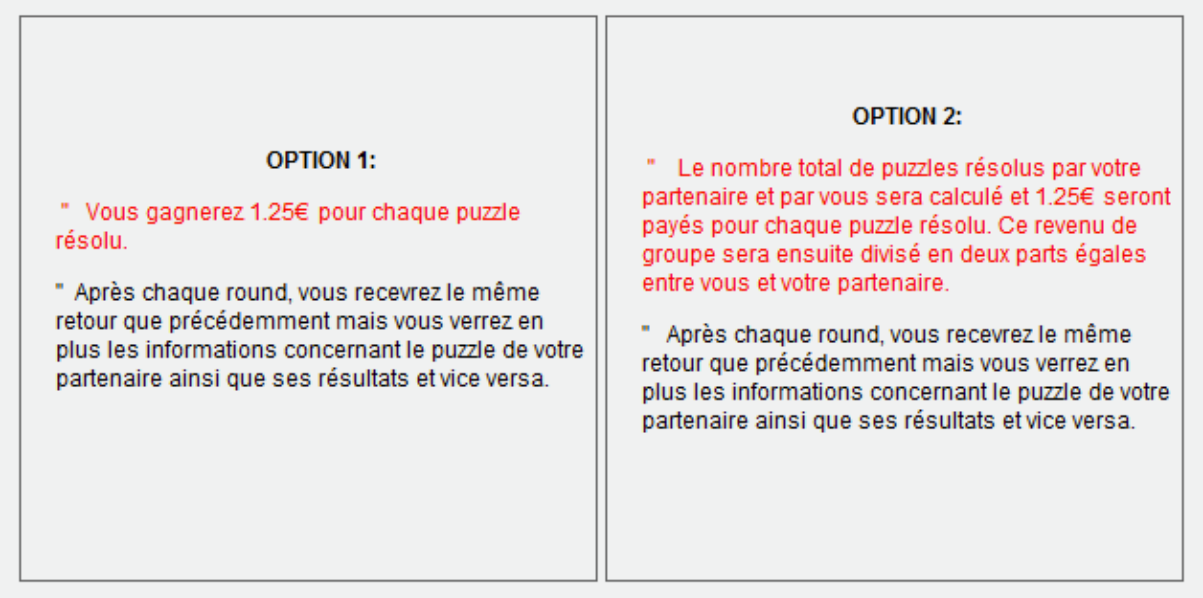
Please press Continue.

In each period, you and your partner will have to solve the same puzzle individually, but you have the choice on how to participate in this part with your partner. You have to choose one of the following two options that will apply to the 5 periods. The differences between the options are highlighted in red on your screen.

Option 1 appears in the box on the left of your screen.

With option 1:
• You will earn €1.25 for each puzzle solved by yourself.
• At the end of each period, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.

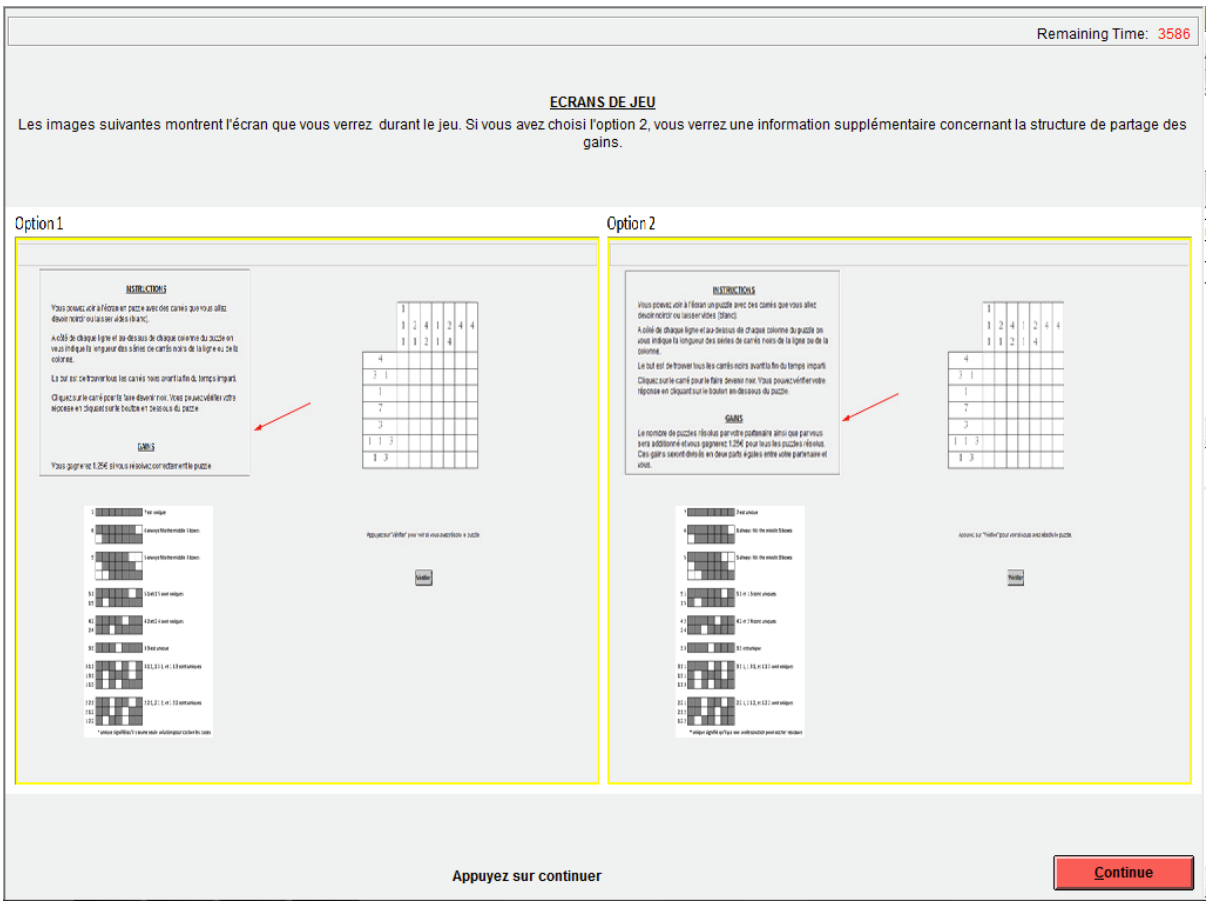
Option 2 appears in the box on the right of your screen.



With option 2:
• The total number of puzzles solved by your partner and by you will be calculated and €1.25 will be paid for each puzzle solved. This group income will then be divided in two equal parts between you and your partner.
• After each round, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.

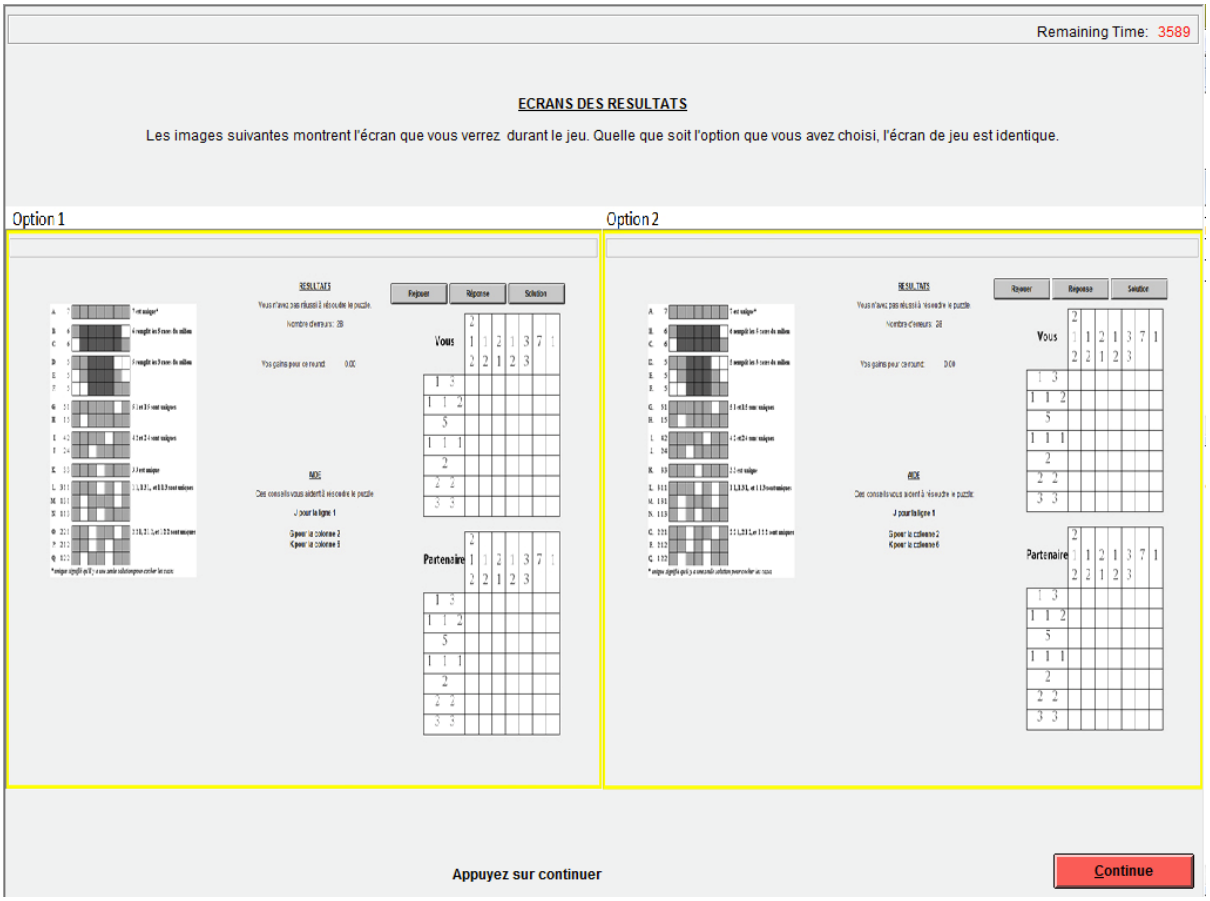
Note that the difference between these options is that you will share your earnings with your partner in option 2, but not in option 1.

Please press Continue to see how the interface changes depending on the option.



The figures show a side-by-side comparison of the screens for both options. Whichever option you have chosen, the screen is identical and it is identical to previous periods. The red arrows point to the difference in the earnings but everything else is similar. You and your partner must solve the puzzle individually. If you have been selected to receive hints, you will have access to them at the bottom left of your screen.

Please press Continue.



You should now see a side-by-side comparison of the results screens for both options.

In each option, you will receive information about your partner's puzzle in the middle of the screen, below your own results.

You will also have access to your partner's grid on the right. So, when you choose Replay or Solution or Answer, it will update with your answer at the top and your partner's answer at the bottom. This is also valid for your partner who will also have access to your results.

Please press Continue.

You are informed that **in the third and last part,** you will remain matched with the same partner as in this second part. But while in this second part you have the choice of the mode of participation with your partner, in the last part:

- you will not have the choice of the option

- and €1.25 will be paid **for the sum of the puzzles solved by your partner and by you. This group income will then be divided in two equal parts between you and your partner.**

Please press Continue.

[***NP treatment*** *(revenue sharing, interactions, hints and new partner in the last part)*]

PART 2

You have now completed Part 1. Please press Continue.

Before you start the second part, you should know that participants in the session ranked in the top half in terms of the number of solved puzzles (*i.e.*, those who solved more puzzles than the median) have been selected to receive hints.

If you have been selected, you should now see the hints displayed in the center of your screen. These hints will always be accessible until the end. If you have not been selected, this is indicated at the top of your screen.

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---
3 minutes

A new part is about to start with different rules. In this part you will participate in the same game for another 5 periods, but in this part you will be paired with a partner. You will keep the same partner for the 5 periods.

If you received hints, your partner did not receive them and conversely, if you did not receive hints, your partner received them. At the bottom of the screen, you can see information about your performance and that of your partner in the first part.

Please press Continue.

In each period, you and your partner will have to solve the same puzzle individually, but you have the choice on how to participate in this part with your partner. You have to choose one of the following two options that will apply to the 5 periods. The differences between the options are highlighted in red on your screen.

Option 1 appears in the box on the left of your screen.

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• You will earn €1.25 for each puzzle solved by yourself.
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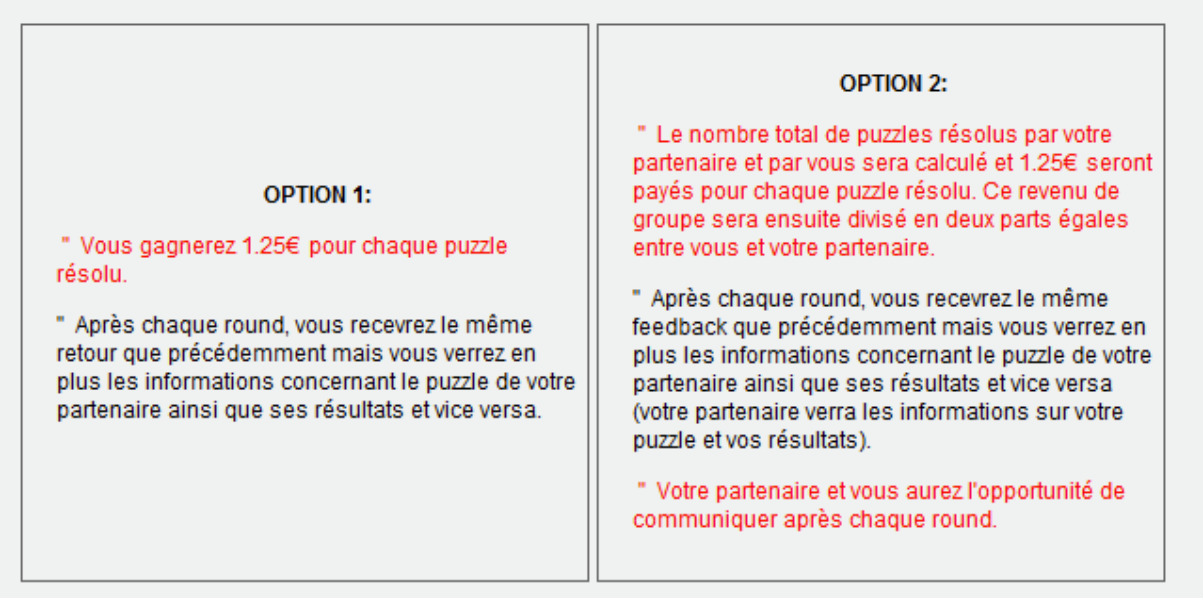
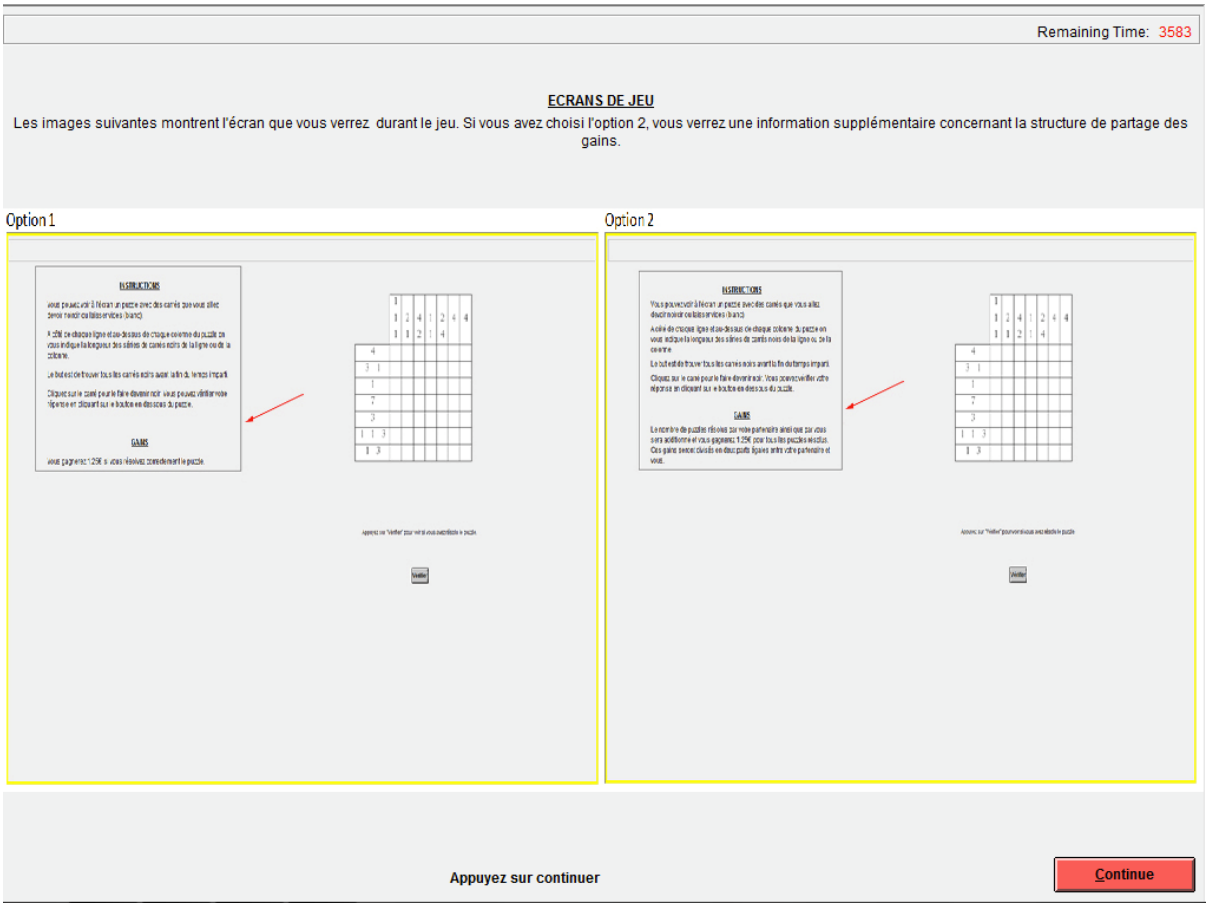
Option 2 appears in the box on the right of your screen.



With option 2:
• The total number of puzzles solved by your partner and by you will be calculated and €1.25 will be paid for each puzzle solved. This group income will then be divided in two equal parts between you and your partner.
• After each round, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.
• Your partner and you will have the opportunity to communicate after each round.

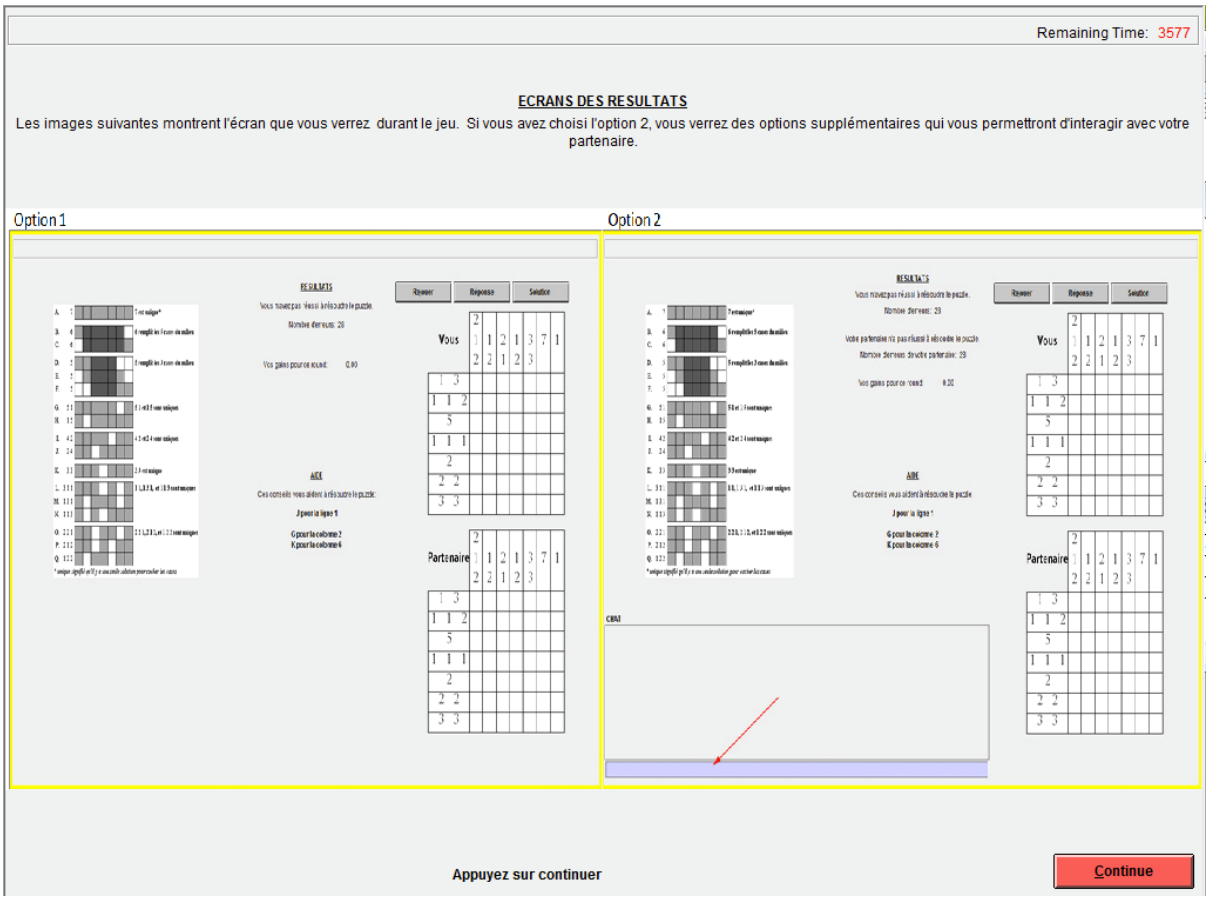
Note that the difference between these options is that you will be able to communicate with your partner and you will share your earnings with your partner in option 2, but not in option 1. Any interaction is done on the results screen only, and not while you are trying to solve the puzzle.

Please press Continue to see how the interface changes depending on the option.



The figures show a side-by-side comparison of the screens for both options. Whichever option you have chosen, the screen is identical and it is identical to previous periods. The red arrows point to the difference in the earnings but everything else is similar. You and your partner must solve the puzzle individually. If you have been selected to receive hints, you will have access to them at the bottom left of your screen.

Please press Continue.



You should now see a side-by-side comparison of the results screens for both options.

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The main differences between option 1 and option 2 have been highlighted with red arrows. For option 1, the results screen is the same as in the previous part. For option 2, the screen allows you to interact with your partner.

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- Second, you can freely exchange messages with your partner by writing inside the chat box at the bottom of your screen.

You can use the chat box to talk about what you want, including the information on the hints if you received them. The only restriction is that you must not try to identify yourself or use offensive language.

Please press Continue.

You are informed that **in the third and last part,** you will be matched with a new partner, different from your partner in this second part. If you have received hints, this new partner will not have received them, and conversely, if you have not received hints, this new partner will have received them.

Moreover, while in this second part you have the choice of the mode of participation with your partner, in the last part:

- you will not have the choice of the option

- you and your partner will not have the opportunity to interact

- and €1.25 will be paid **for the sum of the puzzles solved by your partner and by you. This group income will then be divided in two equal parts between you and your partner.**

Please press Continue.

[***NH treatment*** *(revenue sharing, interactions, no hints and same partner in the last part)*]

PART 2

You have now completed Part 1. Please press Continue.

A new part is about to start with different rules. In this part you will participate in the same game for another 5 periods, but in this part you will be paired with a partner. You will keep the same partner for the 5 periods.

Before you start the second part, you should know that participants in the session have been ranked in the top half in terms of the number of solved puzzles (*i.e.*, those who solved more puzzles than the median) or not.

Your screen will indicate whether you have been ranked in the top half of all participants in terms of the number of solved puzzles.

If you have been ranked in the top half, your partner has not been, and conversely, if you have not been ranked in the top half, your partner has been. At the bottom of the screen, you can see information about your performance and that of your partner in the first part.

Please press Continue.

In each period, you and your partner will have to solve the same puzzle individually, but you have the choice on how to participate in this part with your partner. You have to choose one of the following two options that will apply to the 5 periods. The differences between the options are highlighted in red on your screen.

Option 1 appears in the box on the left of your screen.

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• At the end of each period, you will receive the same feedback as before but you will also see information about your partner's puzzle and results and vice versa.

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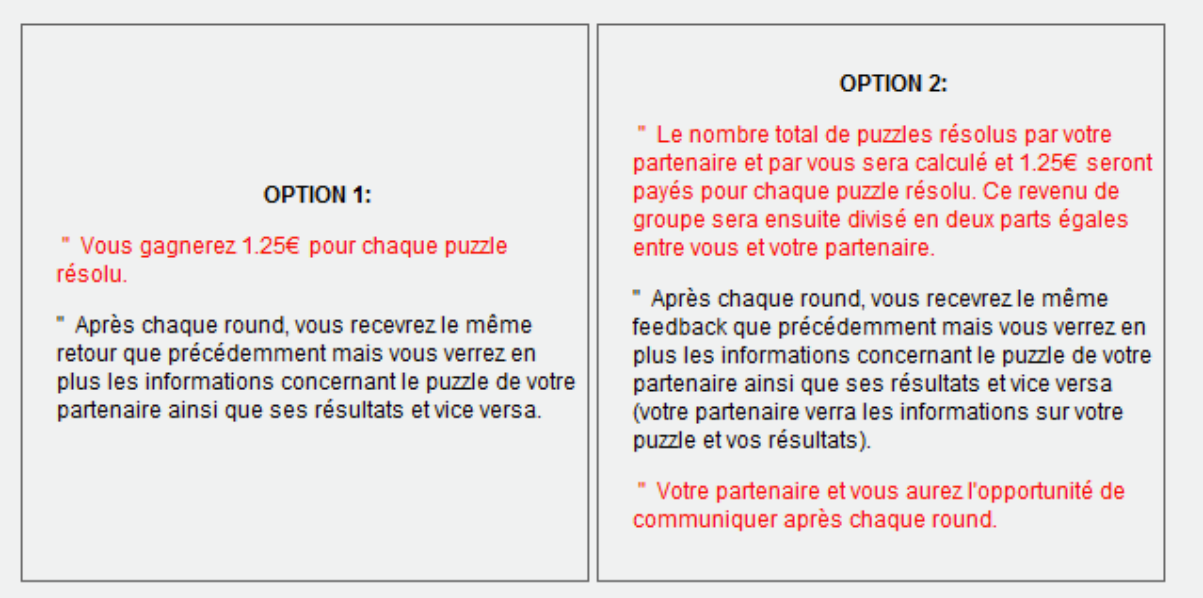

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Note that the difference between these options is that you will be able to communicate with your partner and you will share your earnings with your partner in option 2, but not in option 1. Any interaction is done on the results screen only, and not while you are trying to solve the puzzle.

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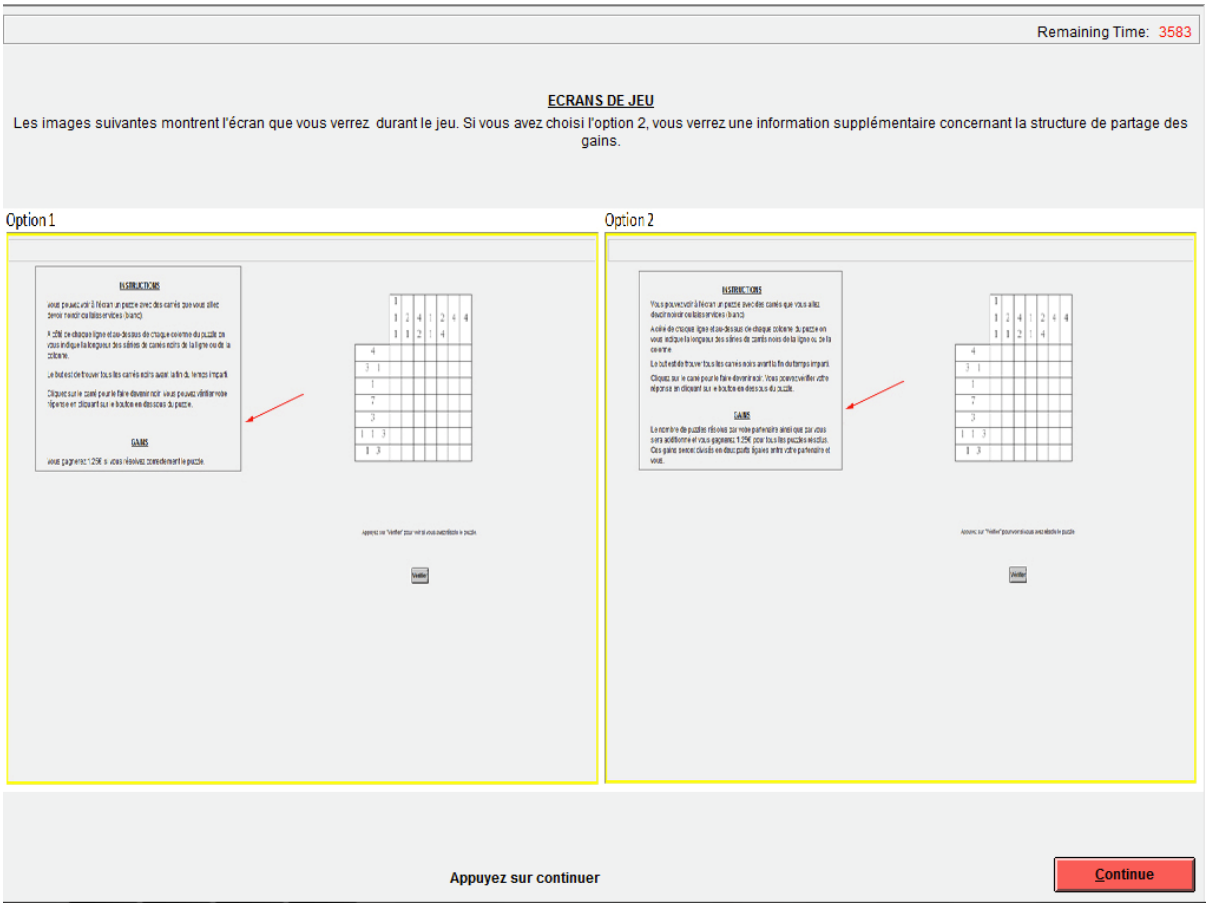


The figures show a side-by-side comparison of the screens for both options. Whichever option you have chosen, the screen is identical and it is identical to previous periods. The red arrows point to the difference in the earnings but everything else is similar. You and your partner must solve the puzzle individually.

Please press Continue.

You should now see a side-by-side comparison of the results screens for both options.

In each option, you will receive information about your partner's puzzle in the middle of the screen, below your own results.

The main differences between option 1 and option 2 have been highlighted with red arrows. For option 1, the results screen is the same as in the previous part. For option 2, the screen allows you to interact with your partner.

- First, you will also have access to your partner's grid on the right. So, when you choose Replay or Solution or Answer, it will update with your answer at the top and your partner's answer at the bottom. This is also valid for your partner who will also have access to your results.

- Second, you can freely exchange messages with your partner by writing inside the chat box at the bottom of your screen.

You can use the chat box to talk about what you want. The only restriction is that you must not try to identify yourself or use offensive language.

Please press Continue.

You are informed that **in the third and last part,** you will remain matched with the same partner as in this second part. But while in this second part you have the choice of the mode of participation with your partner, in the last part:

- you will not have the choice of the option

- you and your partner will no longer have the opportunity to interact

- and €1.25 will be paid **for the sum of the puzzles solved by your partner and by you. This group income will then be divided in two equal parts between you and your partner.**

Please press Continue.

[***All treatments***]

In this current part 2, you will also receive a fixed payment that will be added to your other earnings. This fixed payment was randomly generated for each option. It is between 0 and 100 Euro cents. Each amount in this interval is as likely to be selected. These amounts are probably different depending on the option and across participants.

You can see the amount of the fixed payment at the bottom of each option, *written in blue and italics*.

If you and your partner make the same choice of option (option 1 or option 2), this choice will apply throughout this part. If you make a different choice, the option that will apply to you and your partner will be determined by a random draw in which each option has the same chance of being selected. But in any case, the fixed payment you will earn is that of the option you have chosen.

Now please select your preferred option for this part, either option 1 or option 2.

On your screen, you can now see a summary of your choice and your fixed payment for that part.

Please note that if you did not receive the option of your choice, it is because you and your partner did not make the same choice and one of the two options was randomly drawn.

Please press Continue to start the first period.

[***All treatments except NP treatment*** *(revenue sharing, interactions, hints and new partner in the last part*)]

PART 3

You have now completed part 2. Please press Continue.

In this part you will be paired with the same partner as in part 2 and you will keep the same partner throughout part 3.

This part consists of 5 90-second periods of the game. The total number of puzzles solved by your partner and by you will be calculated and €1.25 will be paid for each puzzle solved. This group income will then be divided in two equal parts between you and your partner.

At the end of this section, several questionnaires will appear on your screen.

Please press Continue to start the first period.

[***NP treatment*** *(revenue sharing, interactions, hints and new partner in the last part)*]

PART 3

You have now completed part 2. Please press Continue.

In this part you will be paired with a new partner, different from your partner in part 2. If you received hints, this new partner did not receive them, and conversely, if you did not receive hints, this new partner received them. You will keep the same partner throughout part 3.

This part consists of 5 90-second periods of the game. The total number of puzzles solved by your partner and by you will be calculated and €1.25 will be paid for each puzzle solved. This group income will then be divided in two equal parts between you and your partner.

At the end of this section, several questionnaires will appear on your screen.

Please press Continue to start the first period.

ONLINE APPENDIX 2. FIGURES

Figure A1. Hints

A. 7

With **7**, fill all boxes.

B. 6

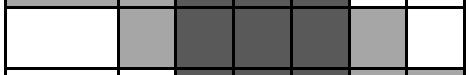
With **6**, fill the 5 boxes in the middle. The sixth box is either on the left or the right.

C. 6

D. 5

With **5**, fill the 3 boxes in the middle.

E. 5



F. 5

G. 5 1

With **5 and 1**, fill the first 5 boxes, leave 1 box unfilled, and fill the last box.

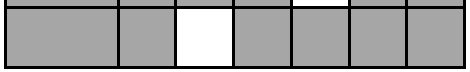
H. 1 5

With **1 and 5**, fill the first box, leave 1 box unfilled, and fill the last 5 boxes.

I. 4 2

With **4 and 2**, fill the first 4 boxes, leave 1 box unfilled, and fill the last 2 boxes.

J. 2 4



With **2 and 4**, fill the first 2 boxes, leave 1 box unfilled, and fill the last 4 boxes.

K. 3 3

With **3 and 3**, fill the first 3 boxes, leave 1 box unfilled, and fill the last 3 boxes.

L. 3 1 1

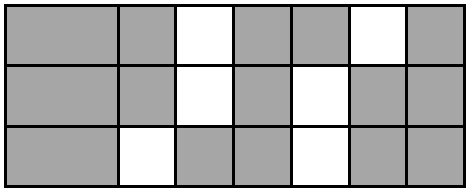
With **3, 1 and 1**, fill the first 3 boxes, leave 1 box unfilled, fill 1 box, leave 1 box unfilled, and fill the last box.

M. 1 3 1

With **1, 3 and 1**, fill the first box, leave 1 box unfilled, fill 3 boxes, leave 1 box unfilled, and fill the last box.

N. 1 1 3

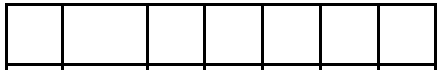
With **1, 1 and 3**, fill the first box, leave 1 box unfilled, fill 1 box, leave 1 box unfilled, and fill the last 3 boxes.

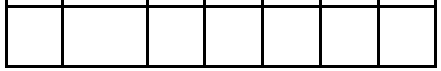
O. 2 2 1  With **2, 2 and 1**, fill the first 2 boxes, leave 1 box unfilled, fill 2 boxes, leave 1 box unfilled, and fill the last box.

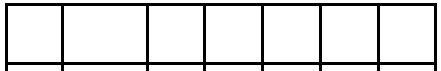
P. 2 1 2 With **2, 1 and 2**, fill the first 2 boxes, leave 1 box unfilled, fill 1 box, leave 1 box unfilled, and fill the last 2 boxes.

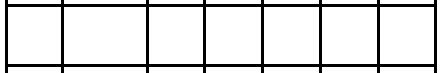
Q. 1 2 2 With **1, 2 and 2**, fill the first box, leave 1 box unfilled, fill 2 boxes, leave 1 box unfilled, and fill the last 2 boxes.

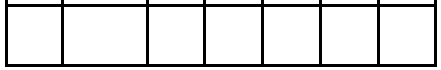
A. 

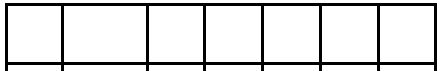
B. 

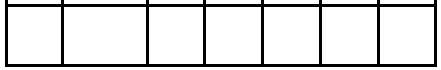
C. 

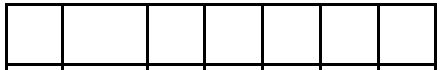
D. 

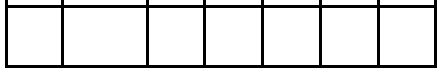
E. 

F. 

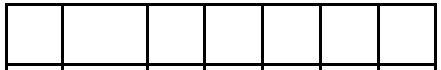
G. 

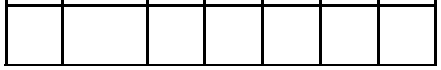
H. 

I. 

J. 

K. 

L. 

M. 

N.

O.

P.

Q.

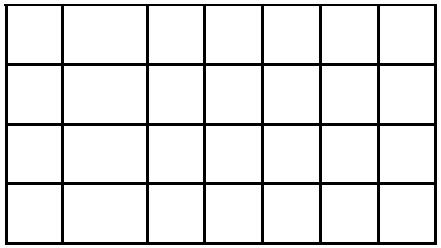


Figure A2. Ice Breaker - Versions 1 and 2

Version 1, Autograph

Your objective is to complete a row or a column or a diagonal of 4 boxes with the signatures of other participants in today's session that correspond to the characteristics described by these boxes. A person can sign only one box and you cannot sign your own sheet.

Has hands bigger than yours _____	Has two sisters _____	Knows who was the President of the French Republic in 1973 _____	Went on holiday in Europe (outside France) this summer _____
Has a cat _____	Knows what the acronym GATE stands for _____	Has the same eye color as you _____	Has worked as a baby sitter _____
Knows how to play piano _____	Has the same favorite bar in Lyon as you _____	Has driven a motorcycle _____	Has a mother with the same name as yours _____
Born in the Paris region _____	Can rub their belly and tap their head at the same time _____	Met someone famous _____	Is taller than 1m83 _____

Version 2, Autograph

Your objective is to complete a row or a column or a diagonal of 4 boxes with the signatures of other participants in today's session that correspond to the characteristics described by these boxes. A person can sign only one box and you cannot sign your own sheet.

Can draw a 6 in the air with one finger and draw an 8 at the same time on the ground with one foot _____	Born outside the Rhône-Alpes region _____	Shorter than 1m83 _____	Has two brothers _____
Has gone scuba diving _____	Knows what the acronym GATE stands for _____	Has the same favorite restaurant in Lyon as you _____	Knows how to play guitar _____
Worked in a store this summer _____	Has the same hair color as you _____	Has smaller hands than yours _____	Has a father with the same name as yours _____
Went on holiday outside Europe this summer _____	Knows who was the President of the French Republic in 1975 _____	Met someone famous _____	Has a dog _____

ONLINE APPENDIX 3. ANALYSIS OF THE CHOICE OF OPTION

Table A1: Probit Regressions on Choice of Option 2 (clustering version)

	Low Ability Types		High Ability Types	
	Model 1L	Model 2L	Model 1H	Model 2H
Own, Stage 1 Correct	-0.077***	-0.083***	-0.052	-0.039
	(0.027)	(0.029)	(0.037)	(0.040)
Partner, Stage 1 Correct	0.010	0.015	0.016	0.019
	(0.045)	(0.045)	(0.024)	(0.023)
Difference, Heckman Draws	0.052***	0.052***	0.011	0.012*
	(0.008)	(0.008)	(0.007)	(0.007)
PR	0.129	0.134	0.387***	0.394***
	(0.097)	(0.097)	(0.087)	(0.084)
NI	0.041	0.045	-0.209***	-0.205***
	(0.081)	(0.081)	(0.071)	(0.070)
NP	0.047	0.054	-0.193***	-0.194***
	(0.099)	(0.096)	(0.072)	(0.070)
NH	0.015	0.042	-0.154*	-0.153*
	(0.086)	(0.085)	(0.083)	(0.083)
Ice Breaker	-0.015	0.003	-0.107*	-0.101*
	(0.062)	(0.063)	(0.056)	(0.056)
CRT Score		0.029		-0.013
		(0.032)		(0.033)
Age		0.010*		0.009
		(0.005)		(0.012)
Female		-0.024		-0.082
		(0.062)		(0.071)
Log-likelihood	-131.32	-129.92	-109.26	-108.24
AIC	280.64	283.85	236.52	240.47
BIC	311.85	325.46	267.73	282.09

Notes: All regressions are based on 237 observations. Marginal effects are reported. Standard errors corrected for clustering are reported in parentheses. Three (***), two (**), and one (*) stars indicate significance at the 1%, 5%, and 10% level, respectively.

Table A2 summarizes the reasons given by high ability types for choosing Option 2 in the post-experimental questionnaire. Reasons are ranked by frequency across all high ability types who choose Option 2. **This is not the order in which participants saw the reasons listed.** We only report options chosen by at least 10% of the subjects. The left column gives data from all five treatments, the middle shows data from the three treatments where teaching is either impossible or unlikely to be beneficial (**NI**, **NP**, and **NH**), and the right reports data from the two treatments (**BL** and **PR**) where teaching is likely to be beneficial since hints are available and partners are fixed in Stages 2 and 3.

Table A2:
Reasons Given by High-Ability Types for Choosing Option 2 in the Post-Experimental Questionnaire

Category	Frequency		
	All Data	**NI**, **NP**, and **NH**	**BL** and **PR**
# Observations	63	17	46
Wanted to teach partner	63%	35%	74%
Thought communication would motivate partner	28%	18%	33%
Prefer to work with others	28%	47%	22%
Didn't want to let partner down by not communicating	25%	24%	26%
Didn't want to let partner down by not sharing revenue	22%	65%	7%
Thought communication would motivate me	14%	18%	13%
Thought partner was good at puzzles	11%	18%	9%
Thought sharing would motivate partner	11%	18%	9%

Notes: Data from post-experimental survey for high ability types who choose Option 2.

ONLINE APPENDIX 4. ANALYSIS OF THE MESSAGE CONTENT IN THE TREATMENTS

To measure whether help is being given, we coded all the messages sent between partners who were assigned Option 2 in **BL**, **PR**, **NP**, and **NH**. Each message was coded independently by two research assistants. The structure of the experiment was explained to the coders, but they were given no information about any hypotheses we had as researchers. They were instructed that they could check as many or few categories as desired. For example, suppose a high ability type writes, "According to the hints, a 7 means you can fill in the whole row." This message provides help *and* refers explicitly to the hints, so it can be labeled as two different categories (specifically in this case, both Category 1 and Category 3 would be checked). A brief description of the coding categories is given below. Cohen's kappas are high for the categories of greatest interest - those relating to teaching - exceeding .60 in all cases.[36]

Coding Categories

1. Propose or give help (e.g. suggestions on how to work the puzzles)
2. Ask for help
3. Explicitly referring to the hints (asking to hear about them for low ability types or talking about their content for high ability types)
4. Emotionally supportive comments related to the puzzles (e.g. celebrating getting a puzzle right, commiserating getting a puzzle wrong, encouraging each other, etc.)
5. Social conversation that is unrelated to puzzles

Table A3: Frequency of Chat (per Period)

	BL	**PR**	**NP**	**NH**
Either Type, Messages Sent	6.42	8.04	5.26	5.11
High Ability Type, Messages Sent	3.76	4.31	2.78	2.69
Low Ability Type, Messages Sent	2.66	3.73	2.48	2.43
Give Help, Messages Sent by High Ability	1.73	1.49	1.09	0.53
Ask for Help, Messages Sent by Low Ability	0.35	0.35	0.29	0.03
Refer to Hints, Messages Sent by Either Type	1.34	1.94	1.03	0.26
Emotional, Messages Sent by Either Type	2.06	3.03	2.04	2.50
Social, Messages Sent by Either Type	2.33	3.13	2.01	2.16

Table A3 summarizes the message content based on the coding exercise, broken down by treatment. The dataset includes all observations where the pair is assigned to Option 2 and chat is possible. Due to the tie-breaking procedure, this includes some individuals who actually choose Option 1. The unit of measurement is the entire conversation during the feedback following a puzzle. For giving and receiving help, we report the frequency for only one type since we are interested in high ability types giving help to low ability types.

Simple non-parametric tests are inappropriate for establishing whether the frequency of messages and message types differ across treatments because there are obvious selection effects. Table A4 addresses this concern by reporting OLS regressions that use a Heckman correction for selection. We use three separate instruments to control for selection: the difference between the Heckman draws for the low ability type, the difference between the Heckman draws for the high ability type, and the tie breaker for cases where the two partners choose different options (coded as 0 if the tie breaker selects Option 1 and 1 if it selects Option 2). All three of these variables are randomly selected by the experimenter and therefore are exogenous. All three are

[36] Cohen's kappas are .891, .678, .722, .476, and .306 for Categories 1 – 5, respectively. Based on feedback from the coders, Categories 4 and 5 were difficult to differentiate because it was often not clear whether or not a comment was related to the puzzles.

potentially correlated with the option a subject is assigned.[37] An observation is the number of messages sent per period by an individual subject in Stage 2. None of the regressions use both partners' data, so there is no need to correct for the correlation between partners' frequencies of interaction. Data from the **NI** treatment are dropped since there is no interaction. All of the regressions include two controls for ability, specifically the number of puzzles solved in Stage 1 by the low ability type and the high ability type in the pair. The omitted category is the two treatments where teaching is unlikely to have financial benefits (**NP** and **NH**). Model 1 considers data from low ability types while Models 2 and 3 use data from high ability types. The dependent variable for Models 1 and 2 is the total number of messages sent per minute, while Model 3 only looks at the provision of help.

Table A4: Number of Messages Sent per Period

	Model 1	Model 2	Model 3
Ability Type	Low	High	High
Type of Message	Any	Any	Help
BL + PR	0.734**	1.292***	0.742***
	(0.288)	(0.339)	(0.221)
Ice Breaker	1.123***	0.969***	-0.045
	(0.301)	(0.350)	(0.224)
Log-likelihood	-294.76	-315.37	-266.38
AIC	611.52	652.74	558.75
BIC	647.06	688.28	594.29

Notes: These regressions are based on 187 observations, including 107 participants assigned to Option 2, and use a Heckman correction. Robust standard errors are reported in parentheses. Three (***), two (**), and one (*) stars indicate significance at the 1%, 5%, and 10% level, respectively.

[37] Looking at first stage results, the difference between the Heckman draws for the low ability type and the tie breaker are significant at the 1% level in all four models. The difference between Heckman draws for the high ability type is never significant. This is consistent with results reported in Table 3.

ONLINE APPENDIX 5. ANALYSIS OF PERFORMANCE

Table A5: Number of Puzzles Solved by High Ability Types in Stages 2 and 3

	Option 1	Option 2	Estimated Difference (*p*-value)
BL	6.81	7.03	0.611 (0.229)
PR	7.28	7.00	0.991 (0.088)
NI	7.00	7.16	-0.212 (0.750)
NP	7.26	6.68	-0.802 (0.114)
NH	6.85	6.52	-0.022 (0.967)