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Social closeness can help, harm and be irrelevant in solving pure coordination problems

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Abstract:

Experimental research has shown that ordinary people often perform remarkably well in solving coordination games that involve no conflicts of interest. While most experiments in the past studied such coordination games among socially distant anonymous players, here we study behaviour in a set of two player coordination games and compare the outcomes depending on whether the players are socially close or socially distant. We find that social closeness influences prospects for coordination, but whether it helps, harms or has no impact on coordination probabilities, depends on the structure of the game.

Highlights

- An experiment tests whether social closeness affects coordination in pure-matching games.
- Coordination is sometimes enhanced by closeness in open-form games.
- Social closeness does not improve coordination in closed-form games.

1. Introduction

Coordination problems are pervasive in social life. While it is well-established that ordinary people are remarkably successful in exploiting focal points to mutual benefit in pure coordination games (e.g., Mehta et al., 1994), how they achieve this remains poorly understood. This paper investigates whether "social closeness" affects coordination success in tacit, "pure-matching" (or "Schelling") coordination games with multiple Nash equilibria.

In his classic book *The Strategy of Conflict*, Schelling (1960) proposed that focal points - salient, but payoff-irrelevant labels (or cues) attached to actions within a pure-matching coordination game – allow individuals to solve equilibrium selection problems (i.e., coordinate with relatively high probability by choosing salient options). How salient a label is, depends on features of the decision situation and the individuals involved; and successful coordination may rely on those features being *shared knowledge*. Thus, what individuals know about each other may be pivotal in triggering shared perceptions of salience so important for coordination success (e.g., Abele et al., 2014).

Most previous empirical studies of focal points in pure-matching games studied this among *socially distant* and *anonymous* players (e.g., Cooper and Weber, 2020). Yet the social distance between individuals might be an important factor determining the extent to which they can exploit salience to achieve coordination in everyday settings. While *close* friends will know more about each other than *distant* acquaintances, it is an open question how this affects the prospects for coordination via focal points. For example, social closeness might promote coordination by enhancing the focality of particular options or impair coordination by, for example, increasing the number of potentially salient options recognised by the players.

We investigate the impact of social closeness in a set of six coordination games with different structures selected to test specific hypotheses about the impact of closeness on coordination success. We explain the experimental design, the specific games we use and the hypotheses we test in Section 2.

2. Experimental Design

Our participants were Swiss Army soldiers attending a four-week Joint Officer Training Programme (JOTP). On arrival, the several hundred officer candidates from across the country were randomly allocated to platoons and classes of approximately 25 people. Over the four weeks, they lived in the training academy and interacted almost exclusively with other

candidates from their own class. After the JOTP, platoons and classes are dissolved, and candidates return to their home bases.[1]

We recruited 308 participants over two JOTP waves in 2016-17. Participants were randomly allocated to either the C-treatment, in which they were paired with a person socially *close* to them, or to the D-treatment, in which they were paired with a person they were unlikely to have met before, i.e., a socially *distant* person. Participants in the *C-treatment* received a printed booklet showing a photograph of one of their classmates (randomly drawn from the same class) with whom they were matched to play in a series of two-player games. It is unlikely that they would have known this person before the JOTP but by the time of completing our study, they would have been interacting with this person across the four weeks of the JOTP. Participants in the *D-treatment* received the same instructions, but the person they were paired with and pictured in their booklets was selected in the expectation that they would be someone the participant considered socially distant: in Wave 1 the pictured person was a soldier who attended a previous JOTP training camp; for Wave 2, it was a Swiss undergraduate student of a similar age to the participants. To facilitate a manipulation check, after the general instructions, participants answered questions to assess how close they felt to the person pictured in their booklet: for this purpose we used the "oneness scale" (Cialdini et al., 1997; Gächter et al., 2015), which measures subjective perception of social closeness on a seven-point scale.

To explore how social closeness affects coordination on focal options, participants took part in both open-form and closed-form coordination games[2] inspired by tasks used in Mehta et al. (1994) and Crawford et al. (2008), respectively.

The three open-form games (games 1-3 in Fig. 1) consisted of writing down: any positive number ("Number"); any year ("Year"); a Swiss town ("Town"). Participants knew that their objective was to give the same response as their partner for a CHF30 (≈USD30.49) payoff (zero otherwise). In these games, the range of possible options is not fixed and this suggests some interesting potential effects of our treatment variable. Consider the Town game. Existing evidence shows that distant pairs are often very successful in coordinating on options such as the city they are in, or their country's capital (consistent with these being focal). Now consider a close pair that happen to know that they are both from the same city but it is not the current

[1] Goette et al. (2012), who previously studied JOTP participants to examine difference between real groups and minimal groups, provide a substantially more detailed description of the JOTP programme.

[2] This paper reports only on a subset of the decisions elicited in the experiment (pure-matching coordination games; see the Experimental Instructions in the online supplemental material).

location or the capital. A priori, it is unclear whether access to additional potential focal points like this would help or hinder coordination.

For the three closed-form games, participants saw each of the pie diagrams (the "P-games") shown as games 4-6 in Fig. 1. For each game, participants had to pick one of the three pie slices knowing that selecting the same slice as their partner would result in the pair of payoffs indicated on that slice (zero otherwise). P-game A is different in structure from the other two P-games in that coordinating on any slice results in identical payoffs. Based on existing evidence, we expected that the visual salience of the bottom-slice (based on both its position and distinctive white colouring) would facilitate coordination among distant players, and we test whether this is enhanced or reduced by closeness.[3] The P-games B and C progressively penalise the relative return to coordination on the visually salient slice. Existing evidence (e.g., Bardsley et al., 2010) demonstrates that such penalties, even when small, dramatically reduce the tendency for individuals to select otherwise focal options. Conditional on replicating this pattern, our design allows us to test whether closeness mitigates the negative impact of the payoff penalties.

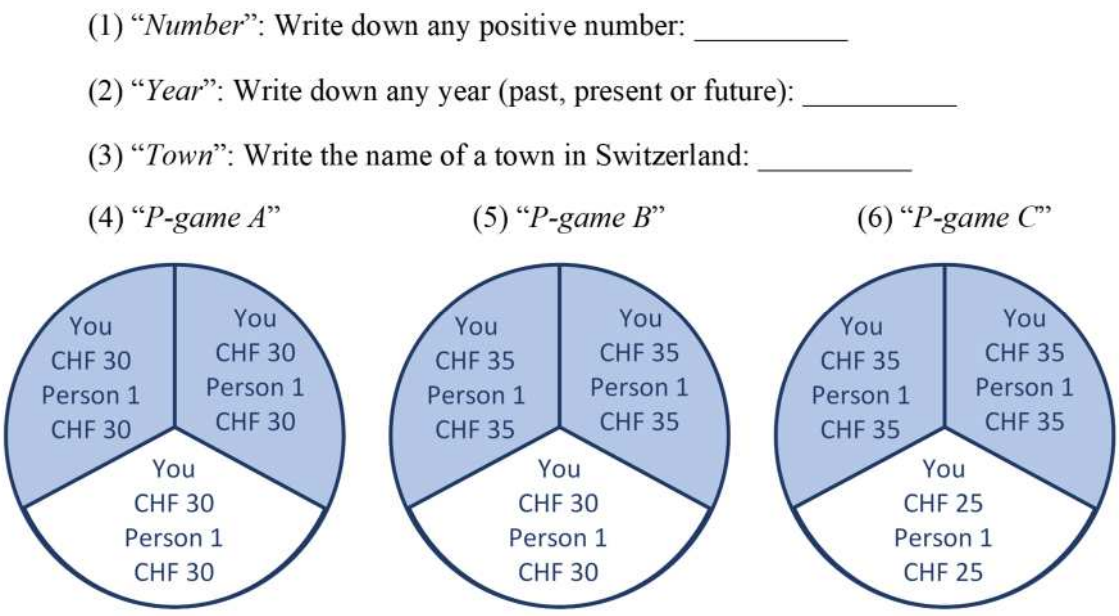

Figure 1. Illustration of the three open-form (1-3) and the three closed-form (4-6) coordination games.

[3] Crawford et al. (2008) find very high rates of coordination in their "Pie-game S1" which is a close analogue of our P-game A.

Participants were not allowed to communicate during the experiment, and they received no feedback prior to the payment stage. At the end of the session (lasting one and half hours), five booklets and five tasks in each booklet were randomly drawn for payment. To exclude the possibility of side payments, participants were paid via bank transfers after the training programme ended. Conditional on being drawn, the average payoff was CHF142.00 (≈USD144.30) in Wave 1 and CHF184.60 (≈USD187.59) in Wave 2.

3. Results

We first conduct a manipulation check: as expected, individuals in the C treatment, on average, report higher closeness ratings with the person they are paired with.[4] Mean oneness: C-treatment=3.96; D-treatment=2.47; Mann-Whitney z=9.25, p<0.001).

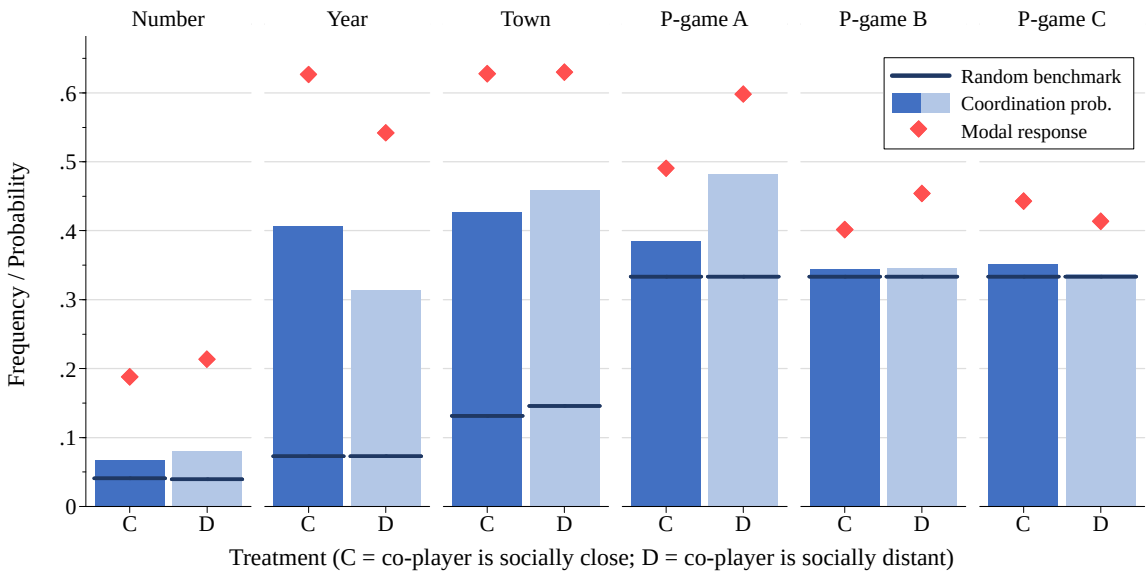

Figure 2. Random benchmarks, coordination probabilities and modal responses.

For the main analysis we examine the influence of social closeness through the lens of a *coordination probability* statistic. For each individual, we calculate their coordination probability on a given task as the likelihood that their answer is the same as that of another randomly selected individual from their group, wave and treatment (see Appendix, section A1, for details). The coordination probabilities reported in Fig. 2 are the average of individual probabilities for a given task and treatment. Fig. 2 also reports a *random benchmark* which is

[4] Contrary to the intended manipulation, 2 participants in the D-treatment did recognise their partner, while 9 participants in the C-treatment did not. We will exclude these 11 participants from the analysis.

the coordination rate that would arise if each subject picked randomly from among the range of 'available' options.[5] The *modal response* (i.e., the relative frequency of the most common response) is also shown in Fig. 2, but since that moves broadly in line with the coordination probability, for brevity we focus on the latter (see Table SM1 for details on the distributions of responses).

Focussing first on the open-form games, we see that – in line with existing evidence (e.g., Mehta et al., 1994) based on distant players – coordination rates are markedly above the random benchmark. Our results indicate that the same is true for close players. While eyeballing shows some differences between average coordination probabilities across treatments (most obviously for "Year"), the direction of difference is not consistent. To test whether treatment differences are statistically significant, we estimate an OLS model for each game by regressing the coordination probability on a treatment dummy, a wave dummy and an interaction (see Appendix, Table A2). We find a significant treatment effect in only one case (the Year game: $\beta_{C\text{-}treatment}$=0.188; std. err.=0.052; p<0.001). The direction of the effect is consistent with closeness *improving* coordination; it is highly significant, but the positive effects of closeness are also confined to Wave 1 only. The open-form games are also ones with a candidate solution which may not be the most immediately obvious but might be expected to emerge via 'team reasoning' (Sugden, 2003; Bacharach, 2006): the answers of '1', the current year or Bern (the Swiss capital and the JOTP location) for the Number, Year and Town games, respectively. There is some indication that these answers are more common in the close treatment for the Number and Year games, but again only in Wave 1 (see Table SM1).

Turning to the closed-form games, we focus first on P-game A. Here we replicate past results of coordination rates much better than chance amongst distant players and we extend existing evidence by showing that closeness *reduces* coordination success ($\beta_{C\text{-}treatment}$ =-0.119; std. err.=0.037; p=0.001). As expected, for P-games B and C, coordination rates fall close to the random benchmark for distant players, consistent with existing evidence (Crawford et al., 2008). Our results show that closeness does nothing to prevent that.

[5] For the open-form games, we use the number of distinct answers given by all subjects in a treatment/wave as the available range (this is reported in Table SM2). The random benchmark is equivalent to the reciprocal of the range of responses hence it takes the value 1/3 by construction in the P-Games. We see no evidence that the range of responses varies systematically with treatment for the open-form games.

4. Summary and Conclusion

We presented evidence from a lab-in-the-field experiment on tacit, two-player, pure-matching coordination games involving pairs of people who are either socially close or distant. We varied two structural features of the games: whether they are open or closed form and whether or not the option expected to be salient in the closed-form game is payoff dominated. We find evidence that both dimensions mediate the impact of closeness. In games that do not penalise coordination on a salient option, our participants' decisions imply coordination rates much better than chance. But while social closeness significantly lifts coordination rates in one open-form game, it hinders coordination in the closed-form game featuring equally-ranked equilibria. Confirming existing evidence, we find that focality loses its force in equilibrium selection when the salient option is also payoff dominated and we extend this finding by showing that closeness does not help recover its power. Hence closeness helps, harms or has no impact on coordination probabilities, depending on the structure of the game.

We close with the obvious but necessary caveat that the patterns identified in our data should not be taken as reliable claims about behaviour more generally, in the absence of replication. That said, our results provide motivation for further work to examine the role of social closeness by testing replicability of our results and, conditional on that, exploring the mechanisms at work.

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Appendix

A1. Coordination Probabilities: Definitions and Calculations

Here we explain how we calculated individual coordination probabilities and task level mean indices derived from them. Let C_{igw}^{D} be the coordination probability for individual *i*, game *g* and wave *w* in the D-treatment. Because the distant players in the D-treatment were a small number of 'seed' players matched repeatedly, in calculating C_{igw}^{D}, we exclude the response of the individual *i* themselves and those of the distant players (which includes by design the person individual *i* was matched with in their booklet). Therefore, after excluding the distant players, if n_{gw}^{D} is the number of respondents giving a particular answer, the coordination probability for individual *i* giving that answer will be $C_{igw}^{D} = (n_{gw}^{D} - 1)/(N_{gw}^{D} - 1)$, where N_{gw}^{D} is the total number of responses to game *g* in wave *w* of the D-treatment. C_{igw}^{D} is the probability that individual *i* gave the same response in *g* as a randomly selected other respondent from wave *w* in the D-treatment, after excluding distant players. The exclusion of the distant players (and, therefore, person individual *i* was matched with in their booklet) from this calculation is driven by consideration of the distant players, who were not members of the current JOTP wave; as such, the distant matches are a different population responding to the tasks in a different context. For symmetry, after excluding the person individual *i* was matched with in their booklet, we calculate individual *i*'s coordination probability in the C-treatment as $C_{igw}^{C} = (n_{gw}^{C} - 1)/(N_{gw}^{C} - 1)$.

We calculate the mean coordination index reported in Table 2, for a given task and treatment by averaging across waves such that $Mean_{gt} = (Mean_{gt}^{w=1} + Mean_{gt}^{w=2})/2$, where *t* represents the relevant treatment. This is to allow for the fact that, for one game in particular (the Year Game) there was a prior expectation that the responses may be different across waves (because the current year is expected to be among the salient options and the waves occurred in two different years).

While our game level coordination index is inspired by the statistic developed in Mehta et al. (1994), ours has a different interpretation. Unlike Mehta et al. (1994), as explained above, we calculate game level coordination indices excluding responses of agents that our participants were paired with. We deviate in this way because of our different research goal and design: we wish to hold constant the nature of respondents, while manipulating the character of the agents with whom they are matched. While our approach means that our index measures a form of 'potential' coordination (from matching participants in ways that they did

not have in mind) it is a valid way to assess differences in the distributions of responses arising across treatments given that the only difference between the treatments is the (close or distant) nature of who our respondents were attempting to coordinate with.

A2. Coordination Probabilities and Treatment Differences

Table A2. Testing for treatment differences in the individual coordination probability.

Dependent variable: coordination prob.	(1) *Number*	(2) *Year*	(3) *Town*	(4) *P-game A*	(5) *P-game B*	(6) *P-game C*
C-treatment	-0.012	0.188***	-0.026	-0.119***	-0.023	0.007
	(0.016)	(0.052)	(0.049)	(0.037)	(0.018)	(0.011)
Wave 2	-0.009	0.143***	0.005	-0.072**	-0.010	0.022**
	(0.014)	(0.042)	(0.040)	(0.033)	(0.018)	(0.011)
C-treatment × Wave 2	-0.002	-0.192***	-0.013	0.042	0.043**	0.016
	(0.019)	(0.065)	(0.060)	(0.040)	(0.021)	(0.018)
Constant	0.085***	0.243***	0.457***	0.519***	0.351***	0.325***
	(0.012)	(0.032)	(0.033)	(0.031)	(0.017)	(0.007)
N	296	295	297	295	297	295

Note: OLS coefficients. Bootstrapped standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01. Variable coding: C-treatment (dummy variable: 0 = Distant; 1 = Close); Wave 2 (dummy variable: 0 = Wave 1; 1 = Wave 2); C-treatment × Wave 2 (interaction: value = 1 for C-treatment and Wave 2; otherwise, 0).

> SUPPLEMENTAL MATERIAL FOR ONLINE PUBLICATION <

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Table SM1. The number of labels and modal responses by treatment and wave.

	C-treatment		*D-treatment*	
Game	No. of Distinct Labels	Modal response (%)	No. of Distinct Labels	Modal response (%)
Wave 1:				
Number	20	1 (23%)	21	7 (22%)
Year	12	2016 (65%)	12	2016 (48%)
Town	5	Bern (63%)	6	Bern (63%)
P-game A	-	White slice (52%)	-	White slice (67%)
P-game B	-	Left slice (40%)	-	Left slice (48%)
P-game C	-	Left slice (40%)	-	Right slice (38%)
Wave 2:				
Number	32	1 (15%)	32	1 (21%)
Year	16	2017 (61%)	16	2017 (61%)
Town	16	Bern (63%)	8	Bern (63%)
P-game A	-	White slice (46%)	-	White slice (53%)
P-game B	-	Left slice (41%)	-	Left slice (43%)
P-game C	-	Left slice (49%)	-	Left slice (45%)

Notes. *No. of Distinct Labels* applies only to the open-form games and reports the number of distinct answers that was given for each of these games in a particular wave and treatment. *Modal response* indicates the most common response in a game (for given treatment and wave) with the corresponding percentage reported in parenthesis.

SM2: General instructions

Welcome to this study and thank you for participating.

In the study, we will ask you to respond to some initial questions and then complete 14 decision tasks. All of the questions and tasks are explained in your copy of this booklet.

We ask that you respond thoughtfully, carefully and honestly. Please note that our interest in your responses is purely scientific: All responses will remain confidential and any results of our analysis will report only aggregate patterns in data and will not identify responses of specific individuals.

The other participants in this room are completing the same study, though the order of tasks faced is different across individuals.

It is important for our study that you do not communicate, in any way, with any of the other participants in this room from now on until the end of this session (which will last about 1 hour). If you have any questions at any point during this session, please raise your hand and one of the researchers will come to assist you. Otherwise, please work on your own to complete the tasks and remember that it is against the rules to try to look at what others are doing or to communicate with others in any way. Also, you should not use any kind of mobile or mobile electronic device during this session.

The tasks you will face do not have right or wrong answers – instead, we are interested to know what you prefer to choose in each task. You do, however, have the opportunity to earn money. In this study you are each paired with one other person. This person's identify is revealed in your booklet. What you might earn depends upon what you choose, what the other person chooses and on luck. Whether you earn money and if so, how much you earn, will be determined as described in the next paragraph.

At the end of the session, we will randomly select five people currently in the room. For these five people, and the five people that they are paired with (so in total 10 people), half of the tasks they complete will be for real. There are a total of 14 tasks in the booklet, so for these 10 people, 7 of the tasks are for real. The seven tasks that are for real will also be selected at random after the end of the session. All of these random selections will be overseen by [Name of Deputy Commander].

For those 10 people who are selected, the maximum possible earnings are CHF400. While you may earn nothing, the possible earnings are significant. So please remember that all of you are equally likely to be selected to face the tasks for real, and any of the tasks in your booklet could turn out to be real for you.

If you are selected to face tasks for real, although what you will earn in total will depend in part on what the other person you are paired with chooses, you will never learn what the other person chose on any individual task. You will only learn what you earned in total from the set of randomly selected tasks.

If there are any questions so far, please raise your hand now.

In a moment we will ask you to open your booklets and begin responding to the questions and tasks. To help you see where responses are required, we have highlighted in grey every point in the booklet where a response is required. Please make sure that you respond to <u>all</u> questions and tasks in these grey shaded areas.

You may now begin.

SM4: Relevant parts of the experimental booklet

Please, note that throughout this booklet, you will be asked to focus on a particular person. This booklet refers to them as “Person 1”. Their picture is shown below and the same picture appears on later pages, too.

You may or may not know this person but we will ask you to have this person in mind when you respond to various different tasks.

Person 1

Across several tasks, you will be asked to make decisions in situations involving two people: one of these people will be person Person 1 who is shown in the photograph, the second person is you. That is, think of yourself as “Person 2” in all those situations.

You may receive a significant amount of money depending on your decisions, the decisions of Person 1 and luck.

Remember, Person 1 is the person shown in this photograph.

Person 1

Before beginning the tasks, please, answer the following 6 questions.

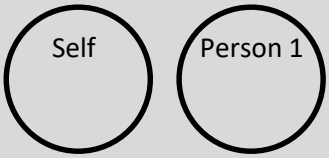
1. Do you recognize Person 1? No Yes
(Please circle the appropriate answer)

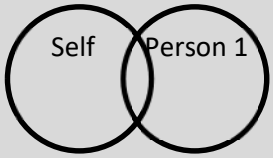
2. Did you know Person 1 before this training? No Yes
(Please circle the appropriate answer)

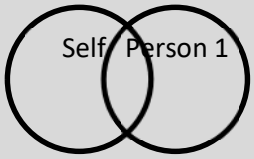
3. Please indicate to what extent you would use the term "**WE**" to characterize you and Person 1 by circling the appropriate number.

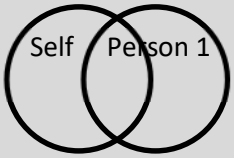
1	2	3	4	5	6	7
Not at all						Extremely

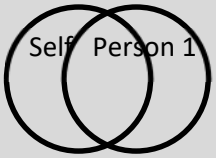
4. Please circle one of the letters A – G below to indicate which of the figures best represents the extent to which **you and Person 1 pictured above are connected**.

A. 

B. 

C. 

D. 

E. 

F. 

G. 

5. Have you had any interaction with Person 1 during training camp? No Yes
(Please circle the appropriate answer)

If 'No' go to next page

6. By circling the appropriate number, please indicate if the interaction you have had with Person 1 would make you more or less inclined to future interaction with them.

1	2	3	4	5	6	7
Definitely No						Definitely Yes

Before turning over, please, check that you have answered all relevant questions on this page.

Remember, Person 1 is the person shown in this photograph.

Person 1

TASK 10

You are paired with Person 1. Your objective in each of the questions below is to give the same answer as Person 1 with whom you are paired.

If you are selected to be paid, both you and the Person 1 will earn money (as described below) for each question on which succeed in giving the same answer.

Please respond to the following three questions. If you are selected to be paid and this is one of the tasks selected to be paid, then for each question on which your answer matches that of Person 1, you and Person 1 will each be paid CHF 30.

1. Write down any year (past, present or future): _____

2. Write down any positive number: _____

3. Write the name of a town in Switzerland: _____

Remember, Person 1 is the person shown in this photograph.

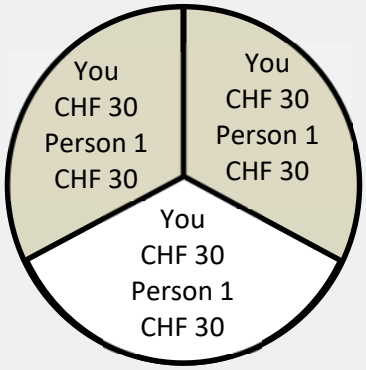
Person 1

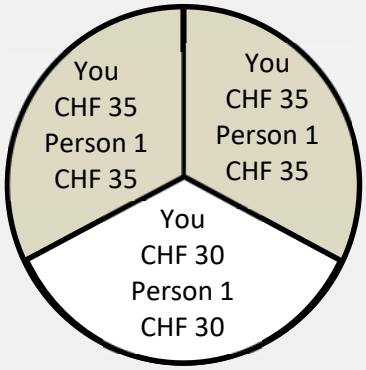
TASK 11

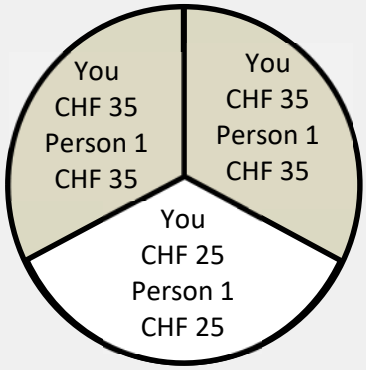
Below you can see 3 different circles. For each circle, you must pick one of the three sectors (i.e., Top, Left, and Bottom) by writing either 'left', 'right' or 'bottom' below the circle (the quadrants you pick can be different for each circle).

You are paired with Person 1. If you are selected to be paid and this is one of the tasks selected to be paid, then for every circle in which the pair of you pick the same sector, you will be rewarded with the amounts shown for each of you in the relevant quadrant.

Please indicate for **each** circle whether you pick Top, Left or Bottom.







Circle 1 **Do you pick Top, Left or Bottom?**	**Circle 2** **Do you pick Top, Left or Bottom?**	**Circle 3** **Do you pick Top, Left or Bottom?**
_____	_____	_____