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Di Girolamo, Amalia; Drouvelis, Michalis

DOI:
10.1016/j.econlet.2015.10.040

Document Version
Peer reviewed version

Citation for published version (Harvard):
Di Girolamo, A & Drouvelis, M 2015, 'The role of gender composition and size of the group in a minimum effort game', *Economics Letters*, vol. 137, pp. 168-170. https://doi.org/10.1016/j.econlet.2015.10.040

The role of gender composition and size of the group in a minimum effort game

Amalia Di Girolamo[*] and Michalis Drouvelis[§]

30 September 2015

Abstract

We report an experiment designed to test for gender differences and group size effects in a repeated minimum effort game. We consider all-male, all-female and mixed gender treatments. We also vary the size of the groups, which can consist either of 3 or 6 members. Our findings indicate significant group size effects but no significant gender differences across treatments.

Keywords: Minimum effort game, Coordination, Gender differences, Group size, Experiments

JEL classification: C91, C92

Acknowledgements: Financial support from the University of Birmingham is gratefully acknowledged.

[*] Department of Economics, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK.
Email: a.digirolamo@exeter.ac.uk
[§] Department of Economics, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK.
Email: m.drouvelis@bham.ac.uk

1. Introduction

In many social interactions, individuals have a common interest to coordinate but doing so is difficult (even when miscoordination is costly) as there are multiple equilibrium outcomes. Understanding how individuals behave in such situations is therefore an important topic for the behavioural and social sciences. In this paper, we ask whether coordination depends on the size and the gender composition of the group. We analyse coordination by studying behaviour in a ten-period minimum effort game as introduced by Van Huyck et al. (1990). One factor that has been shown in the literature to affect successful coordination is the group size. Specifically, previous studies have found that larger groups typically select lower coordination levels (e.g. Knez and Camerer, 1994, 2000; Berninghaus and Ehrhart, 2001; Weber et al., 2004; Chaudhuri et al., 2008). Our experiment considers groups of either three or six subjects and confirms that coordination success is easier to be achieved in smaller than in larger groups. We extend the existing literature by studying whether these results are robust to the gender composition of the groups.

Numerous laboratory experiments (as surveyed by Eckel and Grossmann, 2008) have considered the role of gender differences in relation to various strategic decision making contexts.[1] The main findings from this literature paint a mixed picture regarding whether and if so, in which direction gender differences occur (e.g., Bolton and Katok, 1995; Ellingsen et al., 2013; Dittrich and Leipold, 2014; Brown-Kruse and Hummels, 1993, Brandts and Garofalo, 2012). However, we still know little about whether behaviour in a minimum effort game differs according to individuals' sex.

To the best of our knowledge, the only paper that is designed to test for gender effects in a minimum effort game is due to Dufwenberg and Gneezy (2005). In their design, they consider all-male and all-female sessions; however, subjects were not explicitly told the sex of the counterparts they are interacting with. We deviate from their design by explicitly pointing out to the subjects (both in their instructions and screenshots) that their group consists of members with the same sex. Motivated by evidence suggesting that making the gender group identity salient matters in how men and women cooperate in a social dilemma environment (see Croson, Marks and Snyder, 2003), we hypothesise that women will be more able to achieve higher coordination levels than men. We do not find support in favour of this hypothesis. Despite the fact that, subjects are aware of the gender composition of their counterparts, we find little difference between men and women in their ability to coordinate.[2] This is in line with the results of Dufwenberg and Gneezy (2005).

2. Experimental design and procedures

Experimental design: The framework used in our experiment is the so-called minimum effort game. In this game, subjects form a group of n members and have to decide simultaneously

[1] The importance of gender effects have also been identified in the individual decision making literature (for a review, see Croson and Gneezy, 2009).

[2] As a control treatment, we also had mixed gender sessions whereby subjects were not given information about their counterpart's sex. See Section 2 for more details. Our results in the mixed gender sessions are similar to the all-male and all-female sessions.

and independently on their effort level by choosing an integer from 1 to 7. The payoff of a subject depends on that subject's effort choice as well as their counterpart's minimum effort choice. In particular, the payoff for a given subject is:[3]

$$\pi_i = 20 \cdot \min\{x_1, x_2\} - 10 \cdot x_i + 60$$

The parameters of the payoff function are such that the game has seven Nash equilibria, where each subject selects the same effort level with their counterpart. All seven Nash equilibria are Pareto-ranked: any equilibrium which corresponds to higher effort levels is preferred to any equilibrium which corresponds to lower effort levels.

We employ a 3x2 between-subjects design. We include treatments where the gender composition of a group is the same. This implies that subjects are matched with counterparts of the same gender (men with men, women with women) and they are explicitly told so. Specifically, in their instructions as well as on their screens, we pointed out that subjects in the session were either all males or females (depending on the treatment).[4] We also include treatments where the gender composition of a group is randomly determined (mixed gender groups) and subjects are unable to identify the gender of their counterparts. Additionally,we vary the size of the group: in half of the sessions, the group size is equal to 3 subjects; whereas, in the other half of the sessions, the group size is equal to 6 subjects. We refer to the 6 resulting treatments as follows: "Males_3" (all-male sessions, group size of 3), "Females_3" (all-female sessions, group size of 3), "Mixed_3" (mixed gender sessions, group size of 3), "Males_6" (all-male sessions, group size of 6), "Females_6" (all-female sessions, group size of 6), "Mixed_6" (mixed gender sessions, group size of 6). The minimum effort game is repeated for 10 periods. The group composition is kept fixed (Partners' matching protocol) throughout the experiment.[5] At the end of each period, subjects receive information about their own choice, the minimum effort choice in their group and their payoff in the current period. Table 1 summarizes our experimental treatments.

Table 1. Experimental treatments

	Group size of 3	Group size of 6
All-male	48	54
	(16)	(9)
All-female	42	54
	(14)	(9)
Mixed	51	48
	(17)	(8)

Note: Numbers in the cells indicate the number of subjects who participated in each treatment. Numbers in parentheses indicate the number of independent observations in each treatment.

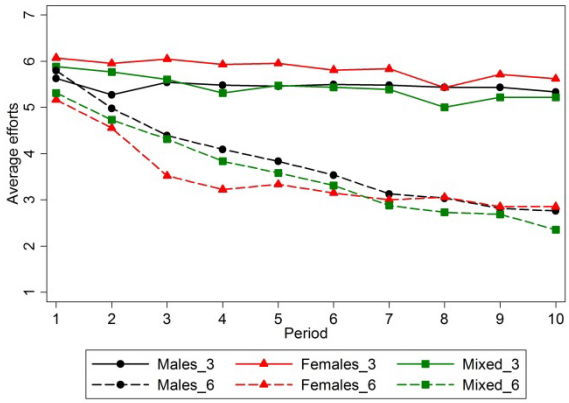
[3] All payoffs are calculated in Experimental Currency Units (ECUs). At the end of the experiment ECUs were converted into GBP using an exchange rate of 10 ECUs = 0.10 GBP.
[4] A copy of the instructions can be found in the Appendix.
[5] As the group composition remains constant across periods, we treat a group as the unit of independent observation.

Procedures: In total, 297 subjects took part in our experiment. All subjects were recruited at the University of Birmingham using ORSEE (Greiner, 2015). The vast majority were undergraduate students from different academic fields. The experiment was conducted in the Birmingham Experimental Economics Laboratory (BEEL). All treatments were computerised and programmed with the software z-Tree (Fischbacher, 2007). On average, sessions lasted approximately 40 minutes and subjects earned, on average, £11.43 (including a show-up fee of £2.50).

3. Results

Figure 1 shows the average efforts in each of the six treatments. We observe that average efforts decline over time for larger groups but whereas they remain stable for smaller groups. For a given group size, average efforts are very similar between men and women. Across all ten periods, average efforts are equal to 5.46, 5.84 and 5.43 in the "Males_3", "Females_3", and "Mixed_3" treatments, respectively. In contrast, the corresponding average efforts are equal to 3.84, 3.47 and 3.57 for the "Males_6", "Females_6", and "Mixed_6" treatments, respectively.

Figure 1. Average efforts



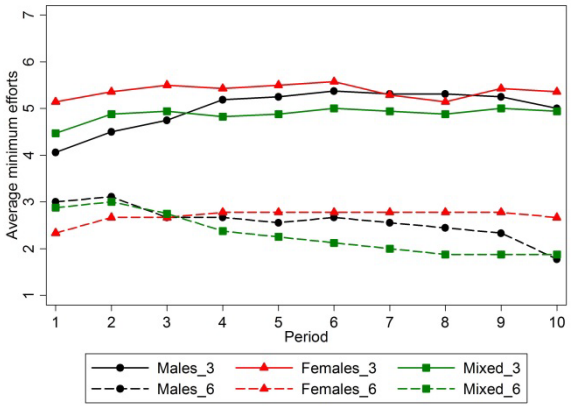
By performing Wilcoxon rank-sum tests, we record significant group size effects both when the group only consists of men (p=0.017) and of women (p=0.004).[6] This result also holds when we compare average efforts in the mixed gender treatments (p=0.012). In sum, our findings indicate that smaller groups choose significantly higher efforts compared to larger groups, which is in line with previous experiments in the minimum effort game literature (e.g., Van Huyck et al., 1990; Van Huyck et al., 2007). In contrast, when we compare behaviour between men and women, for a given group size, we find insignificant differences (for all pairwise comparisons, p>0.310). This result is in line with Dufwenberg and Gneezy (2005), who also find no gender effect in coordination rates as measured by average efforts.

By its nature of the minimum effort game, the minimum effort chosen in each group is important as it determines subjects' payoffs. We next examine whether minimum effort choices differ across treatments by performing Wilcoxon rank-sum tests. Averaging across all

[6] All tests reported in the paper are two-sided.

ten periods, the minimum effort is equal to 5, 5.37 and 4.88 in the "Males_3", "Females_3", and "Mixed_3" treatments, respectively. These differences are not statistically significant at conventional levels (for all pairwise comparisons, p>0.417). The corresponding average minimum efforts are equal to 2.58, 2.7 and 2.3 for the "Males_6", "Females_6", and "Mixed_6" treatments, respectively. Again, these differences are not statistically significant at conventional levels (for all pairwise comparisons, p>0.699). By comparing average minimum efforts when the gender composition of groups is either fixed or mixed, we record significant differences indicating that smaller groups choose significantly higher minimum efforts compared to larger groups (Males_3 vs. Males_6: p=0.014; Females_3 vs. Females_6: p=0.006; Mixed_3 vs. Mixed_6: p=0.014).

Figure 2. Average minimum efforts



Finally, we analyse whether efficiency levels (as measured by average earnings) differ across treatments. The average earnings in each treatment separately are reported in Table 2. Not surprisingly, our analysis indicates that average earnings are not significantly different between men and women (for all pairwise comparisons, p>0.360). However, as a result of being able to coordinate on higher efforts and choose higher minimum effort levels, smaller groups are significantly better off compared to larger groups (Males_3 vs. Males_6: p=0.003; Females_3 vs. Females_6: p=0.006; Mixed_3 vs. Mixed_6: p=0.010).

Table 2. Average earnings

	Group size of 3	Group size of 6
All-male	105.44	73.19
	(21.69)	(19.04)
All-female	109.07	79.30
	(23.51)	(20.49)
Mixed	103.24	70.27
	(27.85)	(16.07)

Note: Earnings are measured in ECUs. Standard deviations are reported in parentheses.

4. Conclusions

This paper reports an experiment investigating whether men and women behave differently in a ten-period repeated minimum effort game. We also consider the impact of different group sizes on coordination as this factor is expected to affect behaviour based on earlier experiments. Consonant with previous studies, our results indicate that coordination success depends on the group size, with smaller groups finding it easier to coordinate compared to larger groups. However, no significant gender effects are recorded despite the fact that subjects were explicitly informed of the gender composition of their group. This result is in line with the paper of Dufwenberg and Gneezy (2005) who did not explicitly mention to subjects the sex of their counterparts. Overall, our results provide evidence that, irrespective of whether subjects are aware of their counterpart's sex, men and women achieve similar coordination levels.

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Appendix – Experimental Instructions (NOT FOR PUBLICATION)

[Note: These are the written instructions as presented to subjects facing the "Females_3" treatment. Amendments with respect to the size (gender composition) of the group are given in square (curly) brackets. In the mixed gender treatments, the sentence "All participants in this session are females {males}" was removed.]

Welcome! You are about to take part in a decision-making experiment. This experiment is run by the "Birmingham Experimental Economics Laboratory" and has been financed by various research foundations. Just for showing up you have already earned £2.50. You can earn additional money depending on the decisions made by you and other participants. It is therefore very important that you read these instructions with care.

It is important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave and you will not be paid. We expect and appreciate your following of these rules.

We will first jointly go over the instructions. After we have read the instructions, you will have time to ask clarifying questions. We would like to stress that any choices you make in this experiment are entirely anonymous. Please do not touch the computer or its mouse until you are instructed to do so. Thank you.

In the instructions, unless otherwise stated, we will not speak in terms of Pounds, but in terms of Experimental Currency Units (ECUs). Your entire earnings will, thus, be calculated in ECUs. At the end of the experiment the total amount of ECUs you have earned will be converted to Pounds at the following rate: **10 ECUs = 0.10 Pounds**. The converted amount will privately be paid to you in cash.

The experiment consists of ten periods. At the beginning of the experiment, participants are divided into groups of three [six]. You will therefore be in a group with two [five] other participants. The groups will stay the same for all ten periods of the experiment. This means that you will always interact with the same two [five] participants. All participants in this session are females {males}.

At no point during the experiment, nor afterwards will you be informed about the identity of the other participants in your group and the other participants will never be informed about your identity.

The Decision Task

In each of the 10 periods, **each participant has to choose a number from 1 to 7** (1, 2, 3, 4, 5, 6, 7). In each period the smallest number chosen in each group will be identified. Your payoff in ECUs is determined according to the following payoff table:

	Smallest number chosen by the participants in your group							
Your Choice		7	6	5	4	3	2	1
	7	130	110	90	70	50	30	10
	6	–	120	100	80	60	40	20
	5	–	–	110	90	70	50	30
	4	–	–	–	100	80	60	40
	3	–	–	–	–	90	70	50
	2	–	–	–	–	–	80	60
	1	–	–	–	–	–	–	70

Your income in ECUs in each period depends on your own choice (indicated by the first column of the table "Your Choice" 7, 6, ..., 1) and the smallest number chosen by the participants in your group, including your number (indicated by the first row of the table 7, 6, 5, ..., 1). Since choices can be a number from 1 to 7, the smallest number can range from 1 to 7. The payoffs are derived in the same way for all participants, that is, the table is the same for all participants.

Your payoff in ECUs is determined by the cell in the row of your choice and the column of the smallest number chosen by the participants in your group. (In the table there are also cells with a "–". This indicates that a combination of your choices and the smallest number chosen in your group is not possible. For example, if your choice is 4, the smallest number in your group cannot be higher, so it cannot be 7, 6, or 5.)

To help you understand the payoff table above, here are a few examples. These are only for illustrative purposes.

• Suppose that you choose 3 and the smallest number in your group is 3: your income is 90 ECUs.

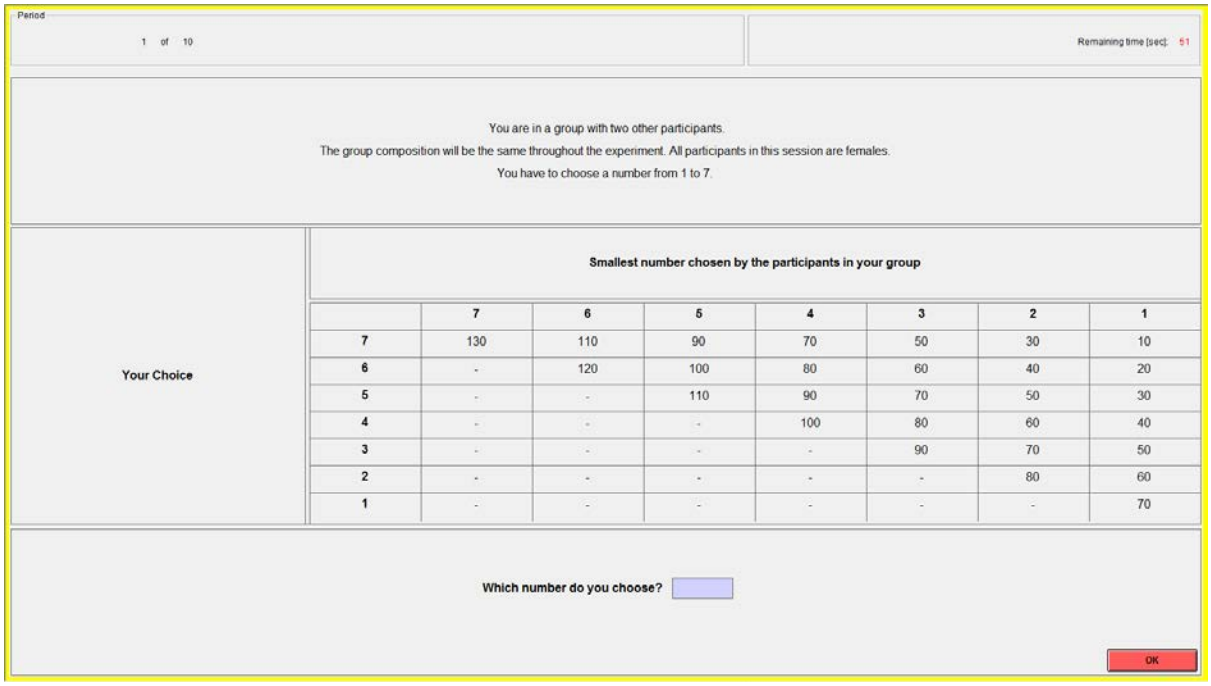
• Suppose that you choose 5 and the smallest number in your group is 3: your income is 70 ECUs.

• Suppose that you choose 5 and the smallest number in your group is 4: your income is 90 ECUs.

• Suppose that you choose 4 and the smallest number in your group is 1: your income is 40 ECUs.

• Suppose that you choose 2 and the smallest number in your group is 1: your income is 60 ECUs.

You will make your decision on a screen that looks as follows:



As mentioned above, you have to choose a number from 1 to 7 in each of the ten periods. You do this by typing a number between 1 and 7 into the box shown on the screen. After that, you will be informed about your choice, the smallest number chosen by participants in your group and your own income in ECUs.

Payments

At the end of period ten you will see your total income in ECUs from all periods and you will be paid 10p for every 10 ECUs, in addition to your £2.50 show-up fee. You will be paid in private and in cash.

Do you have any questions? Please raise your hand and an experimenter will come to your desk. Please do not ask any question out loud.

Control questionnaire

To make sure everyone understands the instructions, please complete the questions below. In a couple of minutes someone will come to your desk to check your answers. Once everybody answers the following questions correctly, the experiment will start. (The decisions and earnings used for the questions below are simply for illustrative purposes. In the experiment decisions and earnings will depend on the actual choices of the participants.).

1. How many periods will there be? _____

2. Will the people in your group be the same from period to period or change from period to period? Same / change

3. Suppose that you choose 4 and the smallest number in your group is 3. What is your income in ECUs? _____

4. Suppose that you choose 7 and the smallest number in your group is 1. What is your income in ECUs? _____

5. Suppose that you choose 2 and the smallest number in your group is 2. What is your income in ECUs? _____

6. Suppose that you choose 5 and the smallest number in your group is 4. What is your income in ECUs? _____