Essays in behavioural economics

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Chapter 4

Handedness Predicts Social Preferences: Evidence Connecting the Lab to the Field

4.1 Introduction

There is a large literature showing that levels of altruism, trust and reciprocity vary strongly across individuals. While we know that culture plays a role[1], it is unclear whether nature too plays a part in forming these differences. In this paper, we analyse the correlation between social preferences and handedness, a trait which is related to important neurological differences. We argue that a significant correlation between handedness and economic choices in social situations would indicate that nature plays an important role in shaping social preferences.

Handedness data can be collected through surveys which allows us to examine the biological origins of altruism, trust and reciprocity in the field as well as the lab. In a first step, we estimate the correlation between handedness and choices in a range of social preference games in the lab. In a second step, we use survey data on altruistic behaviour in the field and attitude questions concerning trust and reciprocity. We can therefore test the external validity of our lab findings by investigating whether they apply to behaviour outside the lab using diverse and representative samples.

Left-handedness is associated with important differences in brain development. For example, while language ability is controlled by the left side (hemisphere) of the brain in 97 percent of right-handers, it is bilateral or controlled by the right side in more than 30 percent of left-handers (Knecht et al., 2000). The brains of left-handers are found to exhibit lower rates of brain hemisphere specialisation in general, meaning that left-handers more commonly use both sides of the brain

[1] Oosterbeek et al., 2004; Henrich et al., 2001; Gächter et al., 2010; Herrmann et al., 2008.

for a given task (Coren, 1993). The main connection between the two hemispheres of the brain (a thick band called corpus callosum, which contains millions of nerves and acts as a data-wire that allows the two hemispheres to "speak" to each other) is thicker in left-handers (Witelson, 1985).[2] It is important to note that this correlation between handedness and the size of the corpus callosum is much stronger in men than in women (Witelson and Goldsmith, 1991; Grimshaw et al., 1995).

Handedness has also been associated with the strength of natural prenatal exposure to testosterone, which is itself thought to have a strong impact on brain development. Prenatal exposure to testosterone has a negative impact on the size of the corpus callosum (Witelson, 1991) and may therefore shift handedness towards the right (Witelson and Nowakowski, 1991). This effect is probably exclusive to men for whom the link between handedness and the size of the corpus callosum is much stronger and who are exposed to much higher levels of prenatal testosterone exposure.[3] The opposite relation (prenatal testosterone being a cause of left-handedness) has also been hypothesised (Geschwind and Galaburda, 1987). The empirical evidence is inconclusive, with some evidence found in both directions.[4]

The psychological literature has found left-handers to be different from right-handers along many dimensions. Often, the effects are stronger in men and it is common to even find opposite effects of handedness for women. Coren (1995), for instance, finds creativity (specifically "divergent thinking") to be positively correlated with left-handedness in men only. Goldberg et al. (1994) find that left-handedness is associated with novelty-seeking, again particularly in males. Looking at several measures of school performance and leadership skills, Faurie et al. (2006) find a positive association with left-handedness for boys but a negative one for girls and Sanders et al. (1982) find the same pattern for spatial ability.

In economics, left-handedness has been associated with higher wages for men but lower wages for women (Denny and O'Sullivan, 2007), higher wages amongst college-educated men (Ruebeck et al., 2007), and worse average outcomes in a range of early childhood development indicators (Johnston et al., 2007). In an experimental study, Hoffman and Gneezy (2010) find that left-handers of both sexes are more competitive. Given that brain differences associated with handedness differ between the sexes and given the findings of the psychological literature, it comes as no surprise that economic studies also find gender differences in the effects of handedness.

A number of previous papers have investigated the link between nature and social preferences in the lab using different methods. One strand of this literature has focused on hormones. A series of

[2]Indeed, it has been hypothesised that handedness arises from differences in the size of the corpus callosum (Witelson, 1985).

[3]Lust et al. (2010) show that higher prenatal testosterone exposure reduces information transfer via the corpus callosum in male subjects only. See Grimshaw et al. (1995) for a summary of the theories (and supporting empirical evidence) linking prenatal testosterone exposure to handedness.

[4]See for example Manning and Peters (2009) or Grimshaw et al. (1995).

placebo controlled studies demonstrates that oxytocin induces higher offers in the trust game (Kosfeld et al., 2005; Baumgartner et al., 2008) and increases generosity in the ultimatum game (Zak et al., 2007). Endogenous oxytocin, stimulated through massage and receiving money in a trust game, increases reciprocity (Morhenn et al., 2008). Burnham (2007) detects a positive correlation between current testosterone levels and rejections in the ultimatum game and Zak et al. (2009), in a placebo controlled study, find testosterone to cause both lower offers and more rejections in men. Conversely, Eisenegger et al. (2010) find that testosterone increases ultimatum offers in women. Randomly treating a sample of post-menopausal women with oestrogen and testosterone, Zethraeus et al. (2009), on the other hand, find no impact on altruism, trust or fairness.

Comparing the behaviour of monozygotic and dizygotic twins, a series of studies demonstrates that giving and reciprocity in the trust game (Cesarini et al., 2008), responder behaviour in the ultimatum game (Wallace et al., 2007), and generosity in the dictator game (Cesarini et al., 2009) are partly hereditary. Yet another strand of the literature has found links between specific genes and behaviour in the dictator game (Knafo et al., 2008; Israel et al., 2009).

In a companion paper using the same data (Buser, 2012, reported in Chapter 3), we correlate the experimental choices in the social preference games with physical markers for the strength of prenatal testosterone exposure, finding that individuals of both sexes with markers indicating stronger prenatal exposure show lower levels of altruism, trust, and positive reciprocity.[5] Moreover, we find some evidence that for female subjects offers and responses in the trust, ultimatum and dictator games vary over the menstrual cycle.

We let a sample of 252 subjects participate in a series of social preference games in the lab, including the standard dictator, ultimatum, public good and trust games. We use a post-experimental questionnaire to collect information on handedness and other demographic variables. We also gather handedness information from the respondents of the LISS internet panel[6] and link it to survey data measuring altruistic behaviour and trust outside of the lab. We also use US data from the National Longitudinal Survey of Youth (NLSY)[7], which contain both handedness information and some indicators of altruism, to further confirm our results.

The rest of the paper is organised as follows. Section 4.2 gives details on the experimental design and the lab data and Section 4.3 describes the experimental results. Section 4.4 describes the survey data and Section 4.5 contains the results obtained using the survey data. Section 4.6 discusses potential biological mechanisms behind our results and Section 4.7 concludes.

[5] Specifically, we use the ratio of the length of the index finger to the length of the ring finger (2D:4D) which is established in utero and is negatively correlated with the strength of prenatal exposure to testosterone in both sexes (Hines, 2011). Further studies correlating 2D:4D with social preferences include van den Bergh and Dewitte (2006), Millet and Dewitte (2006) and Millet and Dewitte (2009).

[6] The LISS panel is a representative Dutch internet panel (www.lissdata.nl).

[7] http://www.nlsinfo.org/

4.2 Experimental design and data

The experiment consists of four social preference games which have been widely used in the literature: a trust game, an ultimatum game, a public good game, and a dictator game. Overall, the experiment lasted for seven rounds and one of the rounds was randomly picked for payment at the end of the experiment. Subjects also received a show-up fee of €10. We ran a total of twelve sessions in December 2009 and January 2010, all of which were conducted in the computer laboratory of the Center for Research in Experimental Economics and Political Decision-Making (CREED) at the University of Amsterdam. The subjects were recruited through CREED's online recruitment system. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). The sessions lasted for approximately two hours and average earnings were around €21.

In the trust game (Berg et al., 1995), two subjects are paired up and each receives an endowment of €10. The first mover (the "Proposer") can then decide how much of his endowment he wishes to send to the second mover (the "Responder"). The amount sent is tripled and the Responder can then decide how much of the money, including his endowment, to send back to the Proposer. Because the Responder has no financial incentive to send back anything, the subgame-perfect Nash equilibrium predicts that the Proposer will not send any money. In the social optimum, on the other hand, the Proposer would send his entire endowment of €10 and the Responder would return less than €30 and more than €10, leaving both parties better off. There is a large literature showing that Proposers send on average around 50 percent of their endowment and that Responders reciprocate by returning on average nearly 50 percent of the received transfer (Levitt and List, 2007).

In the ultimatum game (Güth et al., 1982), the Proposer receives an endowment of €20 while the Responder starts out with nothing. The Proposer decides how much to send to the Responder who can then decide whether to accept or reject the proposal. In case of rejection, both players receive zero, so that the subgame-perfect Nash equilibrium predicts that all positive offers are accepted and Proposers should thus send the lowest possible amount. Again, there is a large literature showing that Proposers send positive amounts, usually in the range between 25 and 50 percent of their endowment, and that Responders are willing to forfeit money by rejecting low offers (Roth, 1995).

The public good game is a generalisation of the prisoner's dilemma game whereby subjects are matched in groups of four and are each endowed with €15. They can then decide how much of the endowment to keep and how much to give to the group. Each Euro given to the group is doubled and split equally amongst the group members such that each Euro given to the group pays 50 Cents to each group member. The social optimum is for all the players to invest everything, but as each player has an incentive to free-ride, the Nash equilibrium predicts zero contributions. There is a

Table 4.1: Lab sample characteristics

	Sample	Women	Men
N	252	157	95
Left-handed	20	11	9
Age	22.1	22.0	22.3
Dutch	72%	69%	77%

large literature reporting substantial positive contributions, usually around 50 percent of the initial endowment in a one-shot setting (Ledyard, 1995).

Finally, we implemented a binary version of the dictator game. In the dictator game, the Proposer again receives an endowment of €20 and has to pick between two options: splitting the pot equally with the Responder (who receives no endowment) or keeping €18 while giving only €2 to the Responder. The Responder has no possibility to reciprocate and the game is consequently a good tool for measuring altruism. The Nash equilibrium of course predicts that the Proposer sends the smallest amount possible, but a large literature finds that when able to decide freely, over 60 percent of subjects send a positive amount (Roth, 1995).

The experiment lasted for seven rounds: two rounds of the ultimatum game, two rounds of the trust game, one round of the public good game, and two rounds of the dictator game (in this order). In all games, only discrete amounts of money could be chosen. For the ultimatum, trust and dictator games each subject played each role exactly once. Subjects were rematched after each round, with the rematching occurring within clusters of eight subjects, and were paired with a different subject in each round.[8] The observations are consequently divided into 34 independent clusters.[9] We take this into account by using clustered standard errors in all regressions.

The fact that all subjects played both roles in each game and played all games in the same order can lead to order effects and experience effects within and between games. The nature of the games makes it impossible to give no feedback at all and we opted for giving full feedback after every round. The effects of experience in previous rounds are in expectation orthogonal to the estimated effects of handedness as subjects are randomly allocated to clusters and rematched across rounds. To further ensure that our results are not due to order effects or past experience, we control for a first mover dummy and past experience in all regressions. This means that in all our regressions, we include controls for the play of opponents in all previous rounds.

[8] With the exception of the public good game which uses groups of four players and in which subjects were matched with at least some players with whom they had previously interacted.

[9] In 5 out of 12 sessions, the number of subjects was not divisible by 8 which leads to 5 clusters which only contain 4 subjects.

The laboratory sample consists of 252 undergraduate students, 157 of whom are female. After participating in the experiment, the subjects also filled out a questionnaire asking whether they are left- or right-handed. We also collected additional demographic information including gender, age and nationality. The responses are summarised in Table 4.1. In our sample 9.5 percent of the men and 7.0 percent of the women are left-handed which is consistent with the literature on handedness which reports a higher prevalence of left-handedness amongst men (McManus, 2002).

4.3 Laboratory results

Table 4.2 contains average choices in the social preference games by handedness and gender. The observed amounts are largely within the range observed in the previous literature, with mean offers in the trust, ultimatum and public good games all being around 40 percent of the endowment. The low proportion of equal allocations in our binary dictator game is also in line with the literature as offers of 50 percent of the endowment are a relatively rare occurrence. Looking at the whole sample, the strongest differences between left and right-handers occur in the trust game, where left-handers give 57 percent more, and in the ultimatum game, where left-handers virtually never reject an offer compared to 13.4 percent of right-handers.

Splitting the sample by gender, it becomes apparent that the effects of handedness differ strongly between men and women. Compared to right-handed men, left-handed men give 86 percent more in the trust game and 26 percent more in the ultimatum game. They also return a higher proportion in the trust game and are much less likely to reject in the ultimatum game. These differences are much weaker in women apart from the difference in the likelihood of rejecting ultimatum game offers. On the other hand, left-handed women are 14 percentage points more likely to be selfish in the dictator game.

We further explore these differences using OLS regressions, the results of which are shown in Table 4.3. The dependent variables are the initial offer and the proportion returned in the trust game in Columns 1 and 2, the initial offer in the ultimatum game and a rejection dummy for ultimatum responders in Columns 3 and 4, the contribution to the public good in Column 5, and a binary indicator for choosing the selfish allocation in the dictator game in Column 6. Using regression analysis allows us to properly control for past experience and take into account clustering, as described in Section 4.2. The regressions in Columns 2 and 4, which deal with responder behaviour, additionally control for the amount received from the proposer. Also, in the regressions using the whole sample we control for gender.

The whole-sample regressions confirm that left-handers give significantly more in the trust game and are less likely to reject an offer in the ultimatum game. Striking differences appear when we

Table 4.2: Descriptive results

	Whole sample:		Men:		Women:	
	left-h.	right-h.	left-h.	right-h.	left-h.	right-h.
Trust offer	6.050	3.845	7.667	4.116	4.727	3.685
	(3.268)	(3.002)	(2.872)	(3.320)	(3.069)	(2.798)
Proportion returned	0.908	0.752	0.995	0.678	0.841	0.795
	(0.641)	(0.716)	(0.542)	(0.697)	(0.735)	(0.726)
Ultimatum offer	8.650	7.935	9.556	7.570	7.909	8.151
	(3.422)	(3.160)	(3.575)	(2.601)	(3.270)	(3.437)
Ultimatum rejection	0.050	0.134	0.000	0.105	0.091	0.151
	(0.224)	(0.341)	(0.000)	(0.308)	(0.302)	(0.359)
PG contribution	6.400	6.228	6.444	5.791	6.364	6.486
	(5.413)	(4.784)	(5.747)	(5.404)	(5.409)	(4.377)
Selfish dictator	0.950	0.875	0.889	0.895	1.000	0.863
	(0.224)	(0.331)	(0.333)	(0.308)	(0.000)	(0.345)

Table 4.3: Handedness and social preferences

	(1) Trust Offer	(2) Proportion Returned	(3) Ultimatum Offer	(4) Ultimatum Rejection	(5) Public Good Contribution	(7) Selfish Dictator
Whole sample:						
Left-handed	2.348***	0.112	0.796	-0.113**	0.139	0.044
	(0.724)	(0.172)	(0.824)	(0.048)	(1.118)	(0.056)
N	252	214	252	252	252	252
Men:						
Left-handed	3.864***	0.359	2.249*	-0.146***	-0.018	0.013
	(1.295)	(0.258)	(1.103)	(0.050)	(1.731)	(0.122)
N	95	80	95	95	95	95
Women:						
Left-handed	1.049	-0.044	-0.187	-0.071	0.180	0.071**
	(0.909)	(0.214)	(1.029)	(0.070)	(1.447)	(0.034)
N	157	134	157	157	157	157
Controls	yes	yes	yes	yes	yes	yes
Offer received	no	yes	no	yes	no	no
Scale	0-10	0-1	0-20	binary	0-15	binary

All coefficients are from OLS regressions. The dependent variables are the initial offer and the proportion returned in the trust game in Columns 1 and 2, the initial offer in the ultimatum game and a rejection dummy for ultimatum responders in Columns 3 and 4, the contribution to the public good in Column 5, and a binary indicator for choosing the selfish allocation in the dictator game in Column 6. Clustered standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Controls consist of gender, nationality and experience in previous games; the regressions in Columns 2 and 4 additionally control for the offer received from the first mover. The regressions in Column 2 only use subjects who received a positive amount from their proposer.

split the sample by gender. Amongst male subjects, the left-handers make offers in the trust and ultimatum games which are both statistically and economically significantly higher. They are also significantly less likely to reject offers in the ultimatum game. While they return a substantially larger proportion of the money received in the trust game, this difference is not statistically significant. Female left-handers show none of these effects but are significantly less likely than other female subjects to choose the generous allocation in the dictator game. At first glance, these results indicate a positive impact of left-handedness on giving rates for men and a negative impact for women.

We first take a closer look at giving behaviour. Relative to their right-handed counterparts, the male left-handers make choices which leave their partners better off in both the trust and ultimatum games. But in the public good and dictator games, where recipients cannot reciprocate, their choices are indistinguishable from those of right-handers. Higher altruism in left-handers is therefore not the explanation. A possible explanation is that left-handed men are indeed more trusting, expecting others to exercise positive reciprocity in the trust game, and expect others to exercise negative reciprocity in the ultimatum game. That is, left-handed men have a stronger belief in the reciprocity and fairness of others.[10]

In Table 4.4, we take a closer look at the link between handedness and reciprocity in the trust game. Here we regress the amount returned in the trust game on a handedness dummy, the amount received from the proposer, and the interaction of these two variables. It becomes apparent that left-handed men do not return more money per se; actually, the coefficient on the handedness dummy is negative and insignificant. Rather, the amount they return increases much more steeply with the amount received from their proposer. While right-handed men return around 85 cents for each Euro sent by the proposer (or around 28 cents for each Euro they receive after the amount is tripled), left-handed men return almost twice as much per Euro. Given that we do not use the strategy method, the amount of rejections in the data is too small in order to conduct the same analysis for the ultimatum game. But in the light of these results, it seems plausible that for left-handed men the willingness to reject reduces faster with an increase in the transfer received and that this leads to the significantly lower likelihood of rejection. These results again indicate that the differences in behaviour between left-handed and right-handed men are not driven by differences in altruism (in that case the left-handers should return more whatever the amount received) but by a stronger willingness to reciprocate.

[10]Similarly, left-handed men might simply be better at inferring the reactions of others so that their higher giving rates translate into higher profits. This is not the case as ultimatum proposer profits are virtually the same for left-handed and right-handed males and trust proposer profits are (insignificantly) lower for left-handers. On the other hand, the ultimatum offers of left-handed men are 12.8 percent less likely to get rejected than those of right-handed men (OLS regression without additional controls; p=0.001).

Table 4.4: Handedness and reciprocity in the trust game

	(1) Amount returned	(2) Amount returned	(3) Amount returned
	Full Sample:	**Men:**	**Women:**
Left-handed	-0.535	-0.918	-1.017
	(0.928)	(1.038)	(1.638)
Offer received	1.047***	0.931***	1.135***
	(0.114)	(0.253)	(0.124)
Left-handed *x* Offer received	0.266	0.772**	0.297
	(0.260)	(0.350)	(0.352)
N	252	95	157
Mean	3.339	2.758	3.771
SD	4.792	4.346	5.018
Controls	yes	yes	yes

All coefficients are from OLS regressions. Clustered standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Controls consist of nationality, gender and experience in previous games.

The female sample shows a strikingly different pattern. There are no significant differences in giving between right-handed and left-handed women in either the trust or the ultimatum game. The same is true for the proportion returned in the trust game and the likelihood of rejection in the ultimatum game. The regression results reported in Column 3 of Table 4.4 show that there are no differences in conditional reciprocity in the trust game either. On the other hand, left-handed women are significantly more likely to be selfish in the dictator game where reciprocity plays no role. Given that the neurological differences associated with handedness differ between men and women, it comes as no surprise that the effects of handedness on social preferences vary between the genders.

This section presented experimental results which imply that the differences in neural structures associated with handedness play a role in shaping individual differences in social preferences. The observed effects of handedness are, for instance, stronger than most of the cultural differences or gender effects observed in the social preference literature.[11] In the following sections, we will investigate whether these links between handedness and social preferences are present in altruistic and reciprocal behaviour outside of the lab as well.

[11]For cultural differences in social preferences refer to the literature mentioned above. For a review of gender differences in social preferences see Croson and Gneezy (2009).

4.4 Survey data

An often voiced concern about laboratory experiments measuring social preferences is that their findings might not be externally valid. Levitt and List (2007) identify a range of potential problems with generalising the results of lab experiments on social preferences including the effect of scrutiny by the experimenter in the lab, lack of anonymity between the subject and the experimenter, the fact that subtle (and potentially inadvertent) manipulations of context can have large effects on behaviour, low stakes compared to decisions outside the lab, and subject self-selection into the experiment. Some of these concerns apply mostly to experiments designed to observe a certain behaviour (say, positive giving in the dictator game) from which general behaviour is inferred (people are altruistic) and less to experiments featuring a within design, comparing with each other the choices made by different groups.

Two important remaining concerns are that the undergraduate student subjects we use in our laboratory experiment might be somehow different from the rest of the population and that people might behave differently in the lab than they would in other contexts. We will address these concerns using survey data on altruism and reciprocity outside of the lab covering a large and diverse population. The aim is to see whether the effects observed in the lab carry over to some of the behaviours the social preference games are intended to predict and to show that they apply to a diverse and international population.

We collected handedness data from responders to the LISS panel, an ongoing Internet panel covering 5000 households comprising 8000 individuals which were selected to be representative of the Dutch population. The participating individuals have already responded to a large number of questionnaires, some of which contain measures of altruism, trust and reciprocity. We asked them whether they are left-handed or right-handed but did not gather any additional information and our analysis therefore makes use of measures that are contained in the existing LISS datasets. In total, 5823 responders answered our handedness questions but the number of observations used in our regressions depends on the number of respondents who replied both to our questions and to the social preference questions already contained in the dataset. A potential worry with this more diverse sample is that amongst the older responders there might be left-handers who were forced to switch to using their right hand by their parents or teachers. This practice was common in the past but has become rare in western countries over the past decades (McManus, 2002). For this reason, we exclude subjects of sixty years or older from our sample which leaves us with 4073 observations.[12]

[12]We also asked responders how strong their preference for left or right was on a scale from 1 – not so strong – to 5 – very strong – and indeed we find that subjects who are sixty years of age or older are much more likely to indicate a weak preference for their hand of choice (Wilcoxon rank-sum test: $p<<0.01$). This phenomenon is much

The data available on (varying subsamples of) the panel members spans dozens of questionnaires containing thousands of variables. Apart from the handedness data we collected, we will limit ourselves to two questionnaires containing measures that are directly relevant to our research. The first study we use is the "European Social Survey" module which contains attitude questions concerning trust and reciprocity. The second study we use is the "Social Integration and Leisure" module of the LISS core study. This questionnaire contains data on altruistic behaviour such as donating money to charitable organisations, doing volunteer work, and performing informal care for another person.[13]

The 1997 wave of the National Longitudinal Survey of Youth (NLSY)[14], a US panel survey covering a nationally representative sample of individuals who were 12 to 16 years old at the end of 1996, contains both information on handedness and a limited number of indicators of altruism. The 2007 questionnaire contains binary indicators for donating money and doing volunteer work which are also available on the LISS panel so that we can further check the external validity of our findings by investigating whether they apply to the US population. All respondents were born between 1980 and 1984 and age-related issues do therefore not come into play.[15]

4.5 Survey results

4.5.1 Trust and reciprocity

Our laboratory results show that left-handers give substantially more in the trust and ultimatum games and that this effect is present in men but not in women. Given that left-handed men do not appear more altruistic in the dictator and public good games, this indicates that they trust others more and believe them to be ready to exercise negative reciprocity. It is hard to see what exactly would constitute a behavioural survey measure of trust and reciprocity, but the "European Social Survey" module of the LISS panel contains three attitude questions which cover different aspects of the respondent's beliefs about other people's reciprocity and trustworthiness, namely whether the respondent believes that others are fair, whether others can be trusted, and whether others deserve

more significant in right-handers ($p<<0.01$) than in left-handers ($p=0.24$), indicating that amongst the older subjects there are many individuals whose preference for right is a weak one. Also, there is no significant relationship between mixed-handedness (defined as indicating a preference strength of 3 or lower) and age for subjects under sixty years of age (OLS regression: $p=0.34$) while this relationship is highly significant for subjects of sixty years or older ($p<0.01$).

[13] A description of the two modules, the questionnaires, and the data can be found online at http://www.lissdata.nl/dataarchive/study_units/view/59 and at http://www.lissdata.nl/dataarchive/study_units/view/6.

[14] http://www.bls.gov/nls/y97summary.htm

[15] The panel oversamples the black and hispanic populations which is not an issue since handedness does not vary with race ($p=0.593$, Fisher's exact test).

Table 4.5: LISS trust sample

	Sample	Men	Women
N	1357	586	771
Left-handed	163	80	83
Age	42.3	42.0	42.6
Monthly income (€)	1451	2047	999
Education level	3.8	3.9	3.7

Education is divided into six categories according to the definition used by Statistics Netherlands.

to be trusted. These questions are "Do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?" (Fairness); "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" (Trust); and "Would you say that most people deserve your trust or that only very few deserve your trust?" (Trust-deserving). Respondents can answer each question on a scale from 0 to 10 whereby a higher number represents more trust.[16]

The Fairness and Trust questions have been used in many previous studies on trust and have been linked to choices in social preference games in the lab.[17] They have been found, for instance, to predict both giving and reciprocating in the trust game (Glaeser et al., 2000; Holm and Danielson, 2005). Fehr (2009), reviewing the trust literature, concludes that answers to trust related survey questions are driven by similar preferences and beliefs as decisions in the trust game.

Table 4.6 regresses the answers to these attitude questions on a left-handedness dummy and a set of controls. We can see that left-handed men, but not left-handed women, are indeed more likely to expect others to be fair, to think that most people can be trusted, and to find that most people are deserving of their trust. These results confirm our experimental finding of higher levels of trust in left-handed men and no effect for left-handed women.

4.5.2 Altruistic behaviour

In this section will concentrate on the analysis of the correlation between handedness and altruistic behaviour outside of the lab. Both the LISS and NLSY data sets do contain some straightforward

[16]For Fairness, 0 represents "Most people would try to take advantage of me" and 10 represents "Most people would try to be fair"; for Trust 0 represents "You can't be too careful" and 10 represents "Most people can be trusted"; and for Trust-deserving 0 represents "Very few people deserve my trust" while 10 represents "Most people deserve my trust".

[17]They have originally been taken from the American General Social Survey (GSS) which has used them to measure trust since 1972.

Table 4.6: Handedness, trust and reciprocity (LISS panel)

	(1)	(2)	(3)	(4)	(5)	(6)
				Fairness		
	Full Sample:		**Men:**		**Women:**	
Left-handed	0.142	0.224	0.407*	0.480**	-0.066	-0.005
	(0.142)	(0.142)	(0.227)	(0.225)	(0.176)	(0.173)
N	1357	1357	586	586	771	771
Mean	6.158	6.158	5.986	5.986	6.288	6.288
SD	1.774	1.774	1.864	1.864	1.692	1.692
				Trust		
Left-handed	0.132	0.215	0.492*	0.598**	-0.188	-0.110
	(0.184)	(0.181)	(0.268)	(0.274)	(0.251)	(0.234)
N	1357	1357	586	586	771	771
Mean	5.841	5.841	5.775	5.775	5.891	5.891
SD	2.168	2.168	2.223	2.223	2.126	2.126
				Trust-deserving		
Left-handed	0.052	0.113	0.409*	0.486**	-0.257	-0.203
	(0.152)	(0.150)	(0.243)	(0.237)	(0.183)	(0.179)
N	1357	1357	586	586	771	771
Mean	6.525	6.525	6.422	6.422	6.603	6.603
SD	1.794	1.794	1.898	1.898	1.709	1.709
Controls	no	yes	no	yes	no	yes
Scale	0-10	0-10	0-10	0-10	0-10	0-10

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; controls consist of age, gender, income and education

Table 4.7: LISS altruism sample

	Sample	Men	Women
N	3691	1620	2071
Left-handed	430	218	212
Age	40.3	40.4	40.2
Monthly income (€)	1372	1949	920
Education level	3.57	3.60	3.54

Table 4.8: NLSY sample characteristics

	Sample	Men	Women
N	7673	3862	3811
Left-handed	923	521	402
Age	24.9	24.9	25.0
Yearly income (US$)	20412	23528	17125
Non-white	3744	1851	1893

measures of altruism. Based on the experimental results from the lab discussed above, we would expect left-handedness to have a negative impact on altruism especially in women.

The "Social Integration and Leisure" module of the LISS core study contains several measures of altruistic behaviour, namely binary indicators for donating money, doing voluntary work, and performing informal care for a sick relative or friend. The data also contains information on membership in charitable organisations for "humanitarian aid, human rights, minorities or migrants". Membership in such an organisation arguably indicates a preoccupation with the common good and thus an altruistic streak. Table 4.9 reports regression results for the effect of handedness on these behaviours. We also show regressions controlling for gender age, gross monthly income and education as these can be expected to have an impact especially on donations.[18]

The donation regressions in Table 4.9 confirm our lab results on altruism: left-handers as a whole are significantly less likely to donate money and this effect is completely attributable to women. After inclusion of controls, female left-handers are around 5.5 percentage points less likely to donate money, which is a sizeable reduction compared to an average proportion of donors of around 38 percent. The picture is less clear for volunteering though. Left-handers as a whole are not

[18]The "Social Integration and Leisure" module of the LISS core study asks respondents whether they donated money to or volunteered for a range of organisations including humanitarian, environmental, and social. Our binary indicators are composite measures which indicate that an individual has donated to or volunteered for at least one type of organisation.

Table 4.9: Handedness and altruistic behaviour (LISS panel)

	(1)	(2)	(3)	(4)	(5)	(6)
			Donating money			
	Full Sample:		**Men:**		**Women:**	
Left-handed	-0.041*	-0.029	-0.007	-0.000	-0.069**	-0.055*
	(0.024)	(0.024)	(0.035)	(0.034)	(0.034)	(0.033)
N	3691	3691	1620	1620	2071	2071
Mean	0.376	0.376	0.354	0.354	0.392	0.392
SD	0.484	0.484	0.478	0.478	0.488	0.488
			Volunteering			
	Full Sample:		**Men:**		**Women:**	
Left-handed	-0.020	-0.012	-0.075**	-0.074**	0.039	0.047
	(0.024)	(0.024)	(0.031)	(0.032)	(0.035)	(0.035)
N	3692	3692	1621	1621	2071	2071
Mean	0.319	0.319	0.304	0.304	0.330	0.330
SD	0.466	0.466	0.460	0.460	0.470	0.470
			Informal care			
	Full Sample:		**Men:**		**Women:**	
Left-handed	-0.005	0.009	0.029	0.030	-0.019	-0.005
	(0.020)	(0.020)	(0.025)	(0.026)	(0.031)	(0.030)
N	3693	3693	1621	1621	2072	2072
Mean	0.195	0.195	0.122	0.122	0.253	0.253
SD	0.396	0.396	0.327	0.327	0.435	0.435
			Membership in humanitarian organisations			
	Full Sample:		**Men:**		**Women:**	
Left-handed	-0.018*	-0.014	-0.012	-0.011	-0.022	-0.017
	(0.009)	(0.009)	(0.012)	(0.012)	(0.014)	(0.014)
N	3691	3691	1619	1619	2072	2072
Mean	0.049	0.049	0.038	0.038	0.057	0.057
SD	0.215	0.215	0.190	0.190	0.233	0.233
Controls	no	yes	no	yes	no	yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; controls consist of age, gender, income and education.

Table 4.10: Handedness and altruistic behaviour (NLSY 97)

	(1)	(2)	(3)	(4)	(5)	(6)
			Donating money			
	Full Sample:		**Men:**		**Women:**	
Left-handed	-0.023	-0.014	0.006	0.007	-0.047**	-0.040*
	(0.014)	(0.014)	(0.018)	(0.018)	(0.022)	(0.022)
N	7673	7673	3862	3862	3811	3811
Mean	0.218	0.218	0.179	0.179	0.258	0.258
SD	0.413	0.413	0.383	0.383	0.438	0.438
			Volunteering			
	Full Sample:		**Men:**		**Women:**	
Left-handed	-0.037**	-0.031**	-0.031	-0.029	-0.037	-0.030
	(0.015)	(0.015)	(0.019)	(0.019)	(0.023)	(0.022)
N	7673	7673	3862	3862	3811	3811
Mean	0.256	0.256	0.234	0.234	0.279	0.279
SD	0.437	0.437	0.423	0.423	0.449	0.449
Controls	no	yes	no	yes	no	yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; controls consist of age, gender, income and race

significantly less keen on doing volunteer work. But the effect is strongly and significantly negative for left-handed men – a reduction of 7.4 percentage points relative to an average propensity of 32 percent – while the coefficient is insignificant and positive for left-handed women. This gender difference is rather unexpected given the lab findings. Left-handers are neither more nor less likely to perform informal care for others. Finally, we find that left-handers are less likely to be a member of a humanitarian organisation. This effect is present for both men and women separately but is only significant at the 10-percent level for the sample as a whole (economically, at 1.8 percentage points the effect is relevant relative to a sample average of 4.9 percent).

Table 4.10 contains regression results for the NLSY sample. These results, based on a sample of American twenty-somethings, mostly confirm the results obtained from the Dutch LISS sample. Again, left-handed women are significantly less likely to have donated money while the effect for men is zero. The magnitude of the effect is 4.0 percentage points which is sizeable compared to a sample average of 21.8 percent. We also find that both men and women are around 3 percentage points less likely to volunteer although the effect is only significant for the sample as a whole. Here the NLSY sample differs somewhat from the LISS sample where a negative effect of left-handedness on volunteering was only observed for the male sub-sample.

Donations are arguably the closest equivalent to the dictator game in as far as the final recipient usually does not know the identity of the donor and has no opportunity to reciprocate. The donation regressions therefore confirm our lab results on altruism as they replicate the pattern found in the lab for the dictator game both with the LISS data and the NLSY data: left-handed women are significantly less likely to donate while there is no significant difference for men. The survey data results nevertheless also confirm that one needs to be cautious when generalising lab results on social preferences to predict pro-social behaviour in general. Volunteering is a very different activity from donating money as it is much more visible and requires more personal involvement. But it is still important to note that the lab results from the dictator and public good games do not indicate the negative correlation between left-handedness and volunteering for males. This finding illustrates that contextual factors, which are eliminated in the lab, can indeed lead to different effects in the field.

4.6 Possible biological mechanisms

Handedness is related to a range of neurological differences and identifying the exact mechanism by which handedness affects social preferences is therefore difficult. In this section, we nevertheless discuss some potential mechanisms, an endeavour which necessarily remains speculative.

As discussed in the introduction, male left-handers have a thicker corpus callosum. This results in an increased capacity for communication between the two hemispheres and suggests that the brains of left-handed men are better integrated in processing information.[19] For instance, left-handers perform better at activities that require rapid transfer of information, such as communication and empathising (Hines et al., 1992).[20] This potentially indicates higher levels of empathy in left-handers, especially for men.

The strength of prenatal exposure to testosterone may be both positively or negatively correlated with left-handedness (Grimshaw et al., 1995). Prenatal testosterone exposure is thought to shift brain development away from a brain geared towards empathy in direction of a brain wired for dealing with systems.[21] It is also a potential cause of autism, a condition associated with very low levels of empathy (Manning et al., 2001). More recent studies point towards a negative correlation of prenatal testosterone exposure with left-handedness especially for men (Lust et al., 2010), implying higher levels of empathy in male left-handers. A positive correlation, implying lower levels

[19] Witelson (1985); Witelson and Goldsmith (1991); Grimshaw et al. (1995)

[20] Also see Baron-Cohen (2003) and the references therein.

[21] See Baron-Cohen et al. (2004) for a review of the large body of research backing the testosterone-empathy link and Baron-Cohen (2003) for a more accessible account.

of empathy in left-handers, seems more likely for women.[22]

Increased empathy has been shown to lead to higher levels of giving in the ultimatum game (Barraza and Zak, 2009) and it is thought that hormones influence altruism and trust through an impact on empathy (Zak, 2011). A link between handedness and empathy via the two above-mentioned neurological mechanisms is therefore potentially behind our results.

4.7 Conclusions

This paper contributes to our knowledge about the determinants of individual differences in social preferences. People differ strongly from each other in their degrees of altruism, trust and reciprocity and the fact that these differences occur even in the tightly controlled environment of lab experiments suggests that, rather than being determined on the spot by circumstantial factors alone, they may be determined by deep-seated differences in preferences. What determines these preferences, we have only just begun to explore. We present evidence from a controlled lab experiment and two large online surveys showing that handedness is significantly correlated to individual levels of altruism, trust and reciprocity. Handedness is a well-documented predictor of neural differences and our results consequently hint at a neural basis for social preferences.

Our lab results show that left-handed men make choices that are markedly different from those of right-handed men when the affected individuals have a chance to reciprocate. Left-handed men are also themselves more likely to exhibit positive reciprocity. These effects are not present in left-handed women who, on the other hand, are less altruistic in the dictator game where reciprocity does not play a role. A potential explanation for the behaviour of male left-handers is that they have a stronger belief in the trustworthiness and reciprocity of others. This would mean that they give more not out of a desire to make the responder better off but because they believe, in the case of the trust game, that their trust will be rewarded and, in the case of the ultimatum game, that low offers would be rejected.

Connecting our lab results to large-scale survey data, we can demonstrate the external validity of our findings to a degree which is usually difficult to accomplish for studies investigating social preferences. The lab result of lower altruism in left-handers translates to lower rates of charitable giving, lower willingness to do volunteer work, and lower rates of membership in humanitarian organisations. Especially for donations, arguably the closest equivalent of the dictator game, the observed patterns in both the Dutch and the US data are consistent with the patterns found in the

[22] Using the same sample as this study, Buser (2012) finds that physical markers for the strength of prenatal testosterone exposure predict lower giving rates in both men and women.

lab. We also use a series of attitude questions which gauge the respondent's beliefs about the fairness and trustworthiness of others to show that left-handed men, but not women, are indeed more likely to think that others are trustworthy and fair, again confirming our lab results. But it needs to be noted that we observe gender differences for some of the survey measures of altruism which do not correspond to those found in the lab. We therefore conclude that one nevertheless needs to be careful when generalising experimental results on social preferences to predict pro-social behaviour in general.

Left-handedness, particularly in men, is associated with a stronger integration of the two hemispheres of the brain and therefore of brain functions. A tentative explanation for our findings is that these differences in neural structures lead to differences in reciprocity and beliefs about other people's reciprocity, potentially because male left-handers find it easier to process and take into account information about others and reckon with their possible intentions. More specifically, our results indicate that brain lateralisation and the size of the corpus callosum play an important role in shaping social preferences.

In summary, our contribution is twofold. Firstly, we show that the neural differences associated with handedness lead to different choices in social preference games in the lab. The observed differences are particularly strong for reciprocal behaviour, which is inextricably linked to our expectations and beliefs concerning the behaviour and motivations of others. Secondly, we examine the link between biological factors and social preferences in the field as well as the lab. We can show that our findings partially carry over to the field where we observe strong effects on the prevalence of altruistic behaviour and trust in large and representative samples from the Netherlands and the US. We conclude that social preferences are at least partially biologically determined.