Older Sisters and Younger Brothers:

The Impact of Siblings on Preference for Competition

(*Personality and Individual Differences*, forthcoming)

Hiroko Okudaira[1]

Okayama University and *University College London*

Yusuke Kinari[2]

Kyushu University

Noriko Mizutani[3]

Institute for Research on Household Economics

Fumio Ohtake[4]

Osaka University

Akira Kawaguchi[5]

Doshisha University

This version: February 2015

Word count: 6,897

[1] Department of Economics, Okayama University, 1-1-3, Tsushima-naka, Kita-ku, Okayama City, Okayama 700-8530, Japan; Tel & Fax +81-86-251-7542; okudaira@e.okayama-u.ac.jp

[2] Graduate School of Economics, Kyushu University; kinari@en.kyushu-u.ac.jp

[3] Institute for Research on Household Economics; mizutani@kakeiken.or.jp

[4] Institute of Social and Economic Research, Osaka University; ohtake@iser.osaka-u.ac.jp

[5] Graduate School of Policy and Management, Doshisha University; akawaguc@mail.doshisha.ac.jp

Older Sisters and Younger Brothers: The Impact of Siblings on Preference for Competition

This version: February 2014

Abstract

Psychology studies have long argued the possibility that sibling structure, such as birth order and the sex of siblings, shapes one's personality traits. One of the core issues involved is that of who rates subjects' personality traits in studies. The present studies (*N* = 135 in Study 1, *N* = 232 in Study 2) surpassed the examinations performed in previous studies by obtaining information regarding one of the key personality traits, preference for competition, using a framework developed via experimental economics rather than subjective ratings. Despite the fact that the two studies involved different types of task, we consistently observed that older sisters exerted a significant impact on their younger siblings in both studies. In particular, having an older sister was negatively associated with men's competitive preferences. We also obtained suggestive evidence that having an older sister was positively associated with women's competitive preferences. Our results support sibling hypotheses from the perspective of experimental economics.

Keywords: Sibling competition, Gender, Competition, Personality, Experimental economics

Word count: 6,897, figures: 6, appendix tables in supplementary material: 3

1. Introduction

According to some psychologists, sibling structure is an important environmental contributory factor in personality. Specifically, sibling structure engenders a systematic trend in the personality traits of those whose siblings follow specific gender patterns. One example is the role-assimilation theory formally analyzed by Brim (1958). Based on a series of observational studies by Koch (1954; 1955a; 1955b; 1956a; 1956b; 1956c; 1956d) on primary school students and their siblings, Brim (1958) reported a tendency for mixed-sex sibling pairs to assimilate traits more typically associated with the opposite gender. For instance, older girls with younger brothers displayed more masculine traits (i.e., competitiveness and self-confidence) relative to their counterparts with younger sisters. Similarly, boys with older sisters exhibited more feminine traits (i.e., kindness and cooperation). Interestingly, this effect was stronger for older sister/younger brother pairs relative to older brother/younger sister pairs. While the role assimilation effect between cross-gender sibling pairs could not explain this particular trend exclusively, similar phenomena specific to the relationships between older sisters and younger brothers have been raised in other psychological studies analyzing home-based activities in school-age children (Stewart, 1983; Stoneman, Brody, & MacKinnon, 1986). These studies typically showed that pairs containing older sisters exhibited the greatest role asymmetry, as older sisters often played the roles of managers or meddlesome caretakers.

Sulloway (1996) provides a possible explanation for this trend by suggesting that the effects unique to older sister/younger brother relationships arise due to a combination of birth order and role taking. Sulloway's (1996) rationale for the effect of birth order on personality traits is based on the notion of sibling competition in evolutionary science. Based on Darwin's principle of divergence, Sulloway (1996) argues that the strategies siblings use to attract parental investment depend on birth order, which ultimately shapes their personality traits. Specifically, firstborn children tend to be more dominant, aggressive, ambitious, and conservative relative to later-born children. This is intended to meet their parents' expectations and standards, thereby defending their stakes against younger rivals with regard to the allocation of parental resources. Therefore, firstborn children, regardless of whether they are male or female, emerge as "alpha males" in their sibling systems (Sulloway, 1996). This could explain why Brim (1958) observed a stronger "role-taking effect" in older sister/younger brother pairs relative to older brother/younger sister pairs, as the effect of role taking is more gender incongruent when the firstborn is female and the laterborn is male.[1]

However, it is important to note that some psychologists disagree with the view that sibling dynamics, particularly birth order, systematically influence personality traits. In fact, this issue is the subject of one of the longest debates in psychology. Although the effects of birth order on personality were first observed by Adler (1928) and have since been tested in thousands of studies, Ernst and Angst's (1983) review of the literature concluded that there were only negligible birth order effects across personality variables.

One of the ongoing issues involved is that of who rates subjects' personality traits in studies. The literature has indeed reported mixed evidence, implying the sensitivity of the results in using personality inventory scores to detect birth order effects. At most, Jefferson, Herbst, and McCrae (1998) found a negligible effect of birth order on self-rated personality traits in a large representative sample; however, they also reported that, in peer-rated traits, laterborns scored higher in Openness and Agreeableness. Although Marini and Kurtz (2011) found no significant effects of birth order on peer, parent, or self-rated Neuroticism-

[1] Sulloway's (1996) notion of the effect of birth order on one's personality has inspired many empirical studies. Catherine Salmon and her coauthors further elaborated on the idea and showed that middleborns fare even less well than lastborns and are therefore less closely connected to family members, as parental investment of resources disproportionately favors lastborns, who do not need to compete against younger siblings for parental resources (e.g., Salmon, 1999; Salmon, 2003; Salmon & Daly, 1998; Salmon, Shackelford, & Michalski, 2012). Birth order studies have also varied in their approaches, such as those involving the analysis of the effects of birth order on risk taking behavior in baseball and those involving the examination of these effects on income redistribution preferences (Sulloway & Zweigenhaft, 2010; Yamamura, 2014).

Extraversion-Openness Five-Factor Inventory scores, Saroglou and Fiasse (2003) found that middleborns were less religious and conscientious in both self and mother ratings. A prevailing explanation for the discrepant findings is that these studies failed to account for differences in socioeconomic backgrounds across families. In fact, some reported observations consistent with Sulloway (1996) when family backgrounds were controlled for in a within-family design (Healey & Ellis, 2007; Paulhus, Trapnell, & Chen, 1999). However, even if one could control for family-specific characteristics, evaluators' prior knowledge regarding birth order could also contaminate results. As Ernst and Angst (1983) suggested, parents, influenced by popular birth order views, could rate their children accordingly. This problem cannot necessarily be addressed by asking about birth order once respondents have rated their siblings' personalities, which was the approach used in some within-family studies (Beck, Burnet, & Vosper, 2006; Paulhus et al., 1999). Being asked to rate one's own and a sibling's personalities may evoke "the indirect suggestion that birth order differences are expected" (Marini & Kurtz, 2011, p. 913).

This study surpassed previous psychological studies by obtaining information regarding one of the key personality traits, preference for competition, using a framework developed via experimental economics rather than subjective ratings.[2] In our experiment, Japanese high school students were asked to solve as many mazes as possible in several tasks that used different payment schemes (Study 1, N = 135). In order to examine whether individuals would opt for a competitive environment, prior to their solving the mazes, the

[2] We consider that preference for competition is a key personality because it is tightly linked to a basic achievement motive (Spence & Helmreich, 1983). In fact, psychology literature has attempted to measure competitive traits for more than a century, proposing several inventory scores and examining their relationships with a major personality inventory (Fletcher & Nusbaum, 2008; Houston, McIntire, Kinnie, & Terry, 2002; Schmit, Kihm, & Robie, 2000). Recently, economics literature has also reported the importance of competitive traits, by showing that the gender gap in preference for competition constitutes a non-negligible reason why women are generally underrepresented on the career ladder (Booth, Cardona-Sosa, & Nolen, 2014; Buser, Niederle, & Oosterbeek, 2014; Gneezy, Leonard, & List, 2009; Niederle & Vesterlund, 2007; Tamiya, Lee, & Ohtake, 2012; Wozniak, Harbaugh, & Mayr, 2014)

experimenter asked them to indicate whether they preferred to be compensated via piece-rate payment or a tournament payment scheme. As reward via the tournament scheme depended on the performances of the other members in a randomly assigned group, the choice to enter the tournament scheme represented a voluntary choice of competitive environment. We then determined which factors, including sibling structure, accounted for tournament scheme choice and tested whether the long-debated sibling hypotheses in psychology could be supported from an experimental economic perspective. These hypotheses were also tested on a dataset taken from another experiment, in which university students engaged in math-solving tasks with a very similar incentive scheme (Study 2, N = 232).

Of course, the mere choice of the tournament payment scheme does not immediately indicate that a subject has a higher preference for competition. Voluntary choice of tournament payment could arise as a result of many other factors. Subjects may opt for a competitive environment because they know that they possess superior ability or enjoy taking risks. This complicated our analysis, as all other factors could also be driven by birth order or the sex of siblings. According to the literature in both psychology and economics, older siblings have an influential effect on the development of younger siblings' cognitive abilities (Azmitia & Hesser, 1993; Maynard, 2002), and this effect is known to be heterogeneous across sexes in older siblings (Dai & Heckman, 2013). Similarly, risk-taking behavior could also be affected by sibling constellation. Consistent with the view that siblings use various strategies to attract parental investment (Sulloway, 1996), they reported that later-born siblings were more likely to take part in high-risk activities (Sulloway & Zweigenhaft, 2010; Longstreth, Longstreth, Ramirez, & Fernandez, 1975; Perkin, 2003). Considering that tournament choice involves the risk that subjects could lose their rewards, there was a possibility that tournament choice in our experiment would represent the extent of subjects' risk tolerance rather than their preference for competition.

Overcoming this point was one of important contributions made by the present study. By adapting the experimental framework proposed by Niederle and Vesterlund (2007), we distinguished preference for competition from other possible confounding factors. In the following analysis, we examined whether sibling constellation contributed to the construction of competitive preference, even after controlling for its effects on other factors such as ability or extent of risk aversion.

2. Study 1: Maze-solving task

2.1. Method

2.1.1 Subjectss

One hundred thirty-five students from four high schools in the Kyoto area of Japan participated in the study (male = 41, female = 94). The mean ages for male and female subjects were 16.9 years (age range: 15–21 years) and 16.8 years (age range: 15–18 years), respectively. Subjects attended one of four sessions, which took place on July 16 and 22 and October 1, 2011. Five confederates took part in the experiment to make up for last-minute subject withdrawal, as the experiment required groups of four subjects. Data from the confederates were excluded from the analysis. Each subject was assigned to a group, completed tasks that involved solving as many mazes as possible, and was awarded points via one of two payment schemes. Subjects sat in individual booths and were unaware of where the other members of their group were sitting or how the others had performed until the experiment concluded. It should be noted that the subjects in this study had fewer siblings (mean = 1.00) relative to the average number (1.46) reported in the Japanese Survey on Household Trends conducted by the Ministry of Health, Labour and Welfare. Therefore, there was less variation in sibling composition in the present sample relative to that of a larger representative sample of Japanese teenagers.

2.1.2. Experimental design and procedure

The experimental design mainly followed the framework used by Niederle and Vesterlund (2007). The experiment consisted of a practice session followed by six tasks. In the practice session, subjects solved mazes on a computer screen for one minute to learn the solutions to the mazes. Figure 1 shows a screenshot of the computer display. Subjects were then required to move cursors from the starting position to the goal point using the arrow keys on their keyboards. They could skip as many mazes as they wished by clicking a skip button on the screen to move to the next maze. They received no points for their performance in the practice session. Upon completion of the practice session, subjects progressed to the tasks, in which they were required to solve as many mazes as possible within three minutes and were awarded points under different payment schemes. In Task 1, subjects received points via piece rate: they received 25 points for every correctly solved maze. Task 2 involved a tournament payment scheme: the subject who correctly solved the largest number of mazes in each group received 100 points for every correctly solved maze, while the other three members received no points. As the points awarded in the tournament scheme depended on the performance of the other three members of the group, subjects were exposed to a competitive environment. These two payment schemes were repeated in Tasks 3 and 4, as improvement in performance between the two payment schemes could have reflected learning effects rather than actual responses to competition. In Task 5, prior to solving the mazes, subjects were asked to choose whether they wanted to be paid under a piece-rate or tournament scheme. The choice in Task 5 was then used to measure each subject’s propensity to opt for competitive environment.

Importantly, the mere choice of the tournament scheme in Task 5 did not immediately indicate that the subject preferred competition. The choice in Task 5 could also have reflected factors that were not directly related to preference for competition. For example, some subjects may have chosen the tournament scheme because they overestimated their abilities relative to those of the other group members (overconfidence). Others may have chosen the piece-rate scheme because they were risk averse (risk aversion) or disliked receiving feedback regarding the quality of their performance relative to that of others (feedback aversion). It is also possible that some subjects chose the tournament scheme because they knew that their maze-solving abilities were sufficient (performance level).

These traits complicated our analysis, as they could also have been driven by birth order or the sex of subjects' siblings. Indeed, older siblings are known to influence the development of younger siblings' cognitive abilities (Azmitia & Hesser, 1993; Maynard, 2002), and more importantly, this influence is known to be heterogeneous across sexes in older siblings (Dai & Heckman, 2013). Sibling composition could have been an important factor; for instance, parents may have encouraged girls with older sisters to play with their sisters in the same environment, leading to the development of more advanced cognitive abilities. Such environments could also have led the subjects to believe that their skills in these types of task were superior to those of their competitors, generating variance in overconfidence according to sibling composition.[3] In a similar vein, birth order is also known to affect risk-taking behavior. Consistent with the view that laterborns use rather adventurous strategies to attain parental resources, studies have reported that younger siblings were more likely to engage in high-risk activities in sports (Sulloway & Zweigenhaft, 2010; Longstreth et al., 1975; Perkin, 2003). Therefore, birth order and the sex of siblings could affect other traits in different ways, making it difficult to interpret the birth order effect by merely considering tournament scheme choice in Task 5.

The goal of implementing Task 6 was to determine whether the subjects' decisions to compete in Task 5 could be explained solely by a higher preference for competition. In Task 6, subjects were asked to choose the payment scheme via which they would receive points *for*

[3] We thank the reviewer for providing us with this example.

their performance in Task 3, the second piece-rate task. If subjects chose the piece-rate scheme, they received 25 points for every correctly solved maze in Task 3; if they chose the tournament scheme, they received 100 points for every correctly solved maze in Task 3 if they were the best performer and no points if they were not. As point allocation was based on past performance, subjects did not solve any mazes in Task 6 but speculated on their relative performance within the group. Therefore, subjects' choices in Task 6 were influenced by some factors, such as overconfidence, risk-aversion, feedback aversion, and performance level, but were not affected by preference for competition (Niederle & Vesterlund, 2007). Conversely, choices in Task 5 involved actual competition and subjects' speculation on their relative performance. Therefore, the decision to compete in Task 5 could be seen as reflective of individual tastes regarding participation in competitions, in addition to overconfidence and risk and feedback aversion. By examining the differences in payment scheme choices between Tasks 5 and 6, individual preferences for competition would be revealed (Niederle and Vesterlund, 2007).

In particular, we tested our hypothesis formally by estimating a binary response model of payment scheme choice in Task 5 after controlling for tournament scheme choice in Task 6 and other relevant traits. In essence, the model estimates for a sibling constellation variable tell us how the individual's probability will increase/decrease if he or she follows a certain sibling structure (e.g., has older brothers), conditional on inherent maze-solving ability and the extent of the individual's overconfidence and risk and feedback aversion. We could purge these covariates because we have information concerning subjects' ability in Tasks 1–4 and their decisions regarding whether to enter the tournament payment scheme in Task 6. As Task 6 did not involve the maze-solving task, but subjects were still required to speculate on how many mazes the other group members had solved, controlling for tournament choice in Task 6 removes all factors other than preference for competition (e.g., overconfidence and risk aversion). The supplementary appendices provide further details regarding the estimation procedure.

Subsequent to completing Tasks 1–5, each subject was asked to estimate his or her rank within the group. The estimated ranks were then used to infer the extent of subjects' overconfidence for analysis. Unlike the study conducted by Niederle and Vesterlund (2007), subjects were not paid for each correct guess regarding rank.[4]

To evaluate subjects' attitudes toward competition accurately, students were incentivized in the following way. Upon conclusion of the experiment, subjects entered a lottery and randomly selected one task of the six for which rewards were offered. Students were paid according to the points awarded for the selected task, plus 500 points as a participation fee. Subjects were awarded prizes rather than cash for their points, as cash transactions were prohibited by the high schools involved in the study. The prizes consisted of various stationery items, and subjects received different combinations of these items according to performance.[5] Special care was taken not to mention the specific prizes that subjects would receive until the experiment concluded, as the subjective value of the prizes could vary between subjects; therefore, they were simply instructed to earn as many points as possible.

Upon conclusion of the experiment, subjects were asked to complete a questionnaire containing items concerning demographic information including sibling composition. This information was used to examine the extent to which sibling structure systematically affected a subject's choice of the tournament scheme in Tasks 5 and 6, thereby revealing their preference

[4] By paying for each correct guess in the early version of our experiment, we unexpectedly faced a situation in which some subjects chose a strategy in which they solved none of the mazes in tasks with the tournament payment scheme and "guessed" that they ranked the lowest in a group. This strategy maximized total payment when their expected probability of winning the tournament was initially low.

[5] Prizes were selected with the permission of the high schools involved in the study. Prizes included three colored clips (25 points), a clear folder (50 points), a memo-pad (100 points), five colored pens (500 points), a mechanical pencil and a plastic school bag (1,000 points), and a fabric school bag (1,500 points). Upon conclusion of the experiment, students received a combination of these prizes. Rewards: 100 points was roughly equivalent to 100 JPY, which was equivalent to approximately 1 USD at the time of writing.

for competition.

2.2. Results

Figure 2 presents the proportion of subjects who chose to compete in the tournament payment scheme in Task 5 according to sex and sibling composition. Subjects could belong to more than two of the categories shown in Figure 2, if they had more than two siblings (e.g., if both "has younger sisters" and "has older sisters" applied). The graph was consistent with the sibling hypotheses suggested by Brim (1958) and Sulloway (1996). Despite the fact that more men than women generally entered the tournament scheme (mean tournament entry rates: 61% and 23.4% respectively), the gender gap was remarkably reduced when certain groups of subjects were compared. For example, 39% of women with a younger brother entered the tournament in Task 5, while only 38% of men with an older sister entered the tournament. However, the variation in preference for competition by sibling composition is not immediately apparent in Figure 2. As mentioned in Section 2.1.2, the raw differences in tournament scheme choice could have indicated variation in confounding factors such as overconfidence, risk aversion, feedback aversion, and performance level. To determine whether sibling structure affected individual preference for competition, we needed to purge these confounding factors from the raw differences in choice of the tournament scheme shown in Figure 2.

For this reason, we tested our hypothesis formally by estimating a binary response model of payment scheme choice in Task 5. Figure 3 shows the estimated marginal effects for sibling constellation variables from probit model estimations, in which effects were estimated as the difference from the effect on the rest of male or female observations.[6] The positive value indicates that the individual has higher preference for competition than the rest of the men/women do, while the negative value indicates the opposite. As the vertical axis measures

[6] The detailed estimation results for Figure 3 are presented in Table B1 in the supplementary appendices.

the difference between the subject and the rest of either the men or the women, the bars are not directly comparable between sibling constellation groups. The estimated effects roughly supported the sibling hypothesis. For example, having older sisters reduced men's propensity to select the tournament scheme by 27% relative to other men, with all other covariates being fixed (p = 0.028). The magnitude of this decrease was almost comparable in size to the estimated negative effect of being female on choice of the tournament scheme (-41%).[7] Therefore, men with older sisters showed lower preference for competition. In contrast, having younger brothers increased women's propensity to compete, although this did not differ significantly from zero (p = 0.11).

3. Study 2: Math-solving task

3.1 Method

The purpose of conducting a second study was to complement the small sample size in Study 1. Our second study used a larger experimental dataset (N = 232), which was originally obtained for the Institute of Social and Economic Research collaboration project conducted at Osaka University.[8] In the

experiment, subjects were asked to solve a sequence of counting problems in a very similar framework to that used in Study 1. We examined whether a similar pattern would be observed in a larger sample of subjects engaged in a math-solving task.

3.1.1. Subjects

Two hundred thirty-two students from Osaka University participated in the study (men

[7] The estimate for being female is presented in the first row of Model 6 in Table B1 (supplementary material).
[8] Part of this project was published in another study (Mizutani, Okudaira, Kinari, & Ohtake, 2009), in which the Niederle and Vesterlund (2007) gender-gap hypothesis was tested with Japanese university students.

= 114, women = 118). The mean ages for men and women were 20.1 years (age range: 18–29 years) and 20.3 years (age range: 18–25 years), respectively. Subjects attended one of twelve sessions, which took place between 2007 and 2008 (November 12, 14, and 15 in 2007 and December 16, 18, and 19 in 2008). As in Study 1, each subject was assigned a group of four subjects and was unaware of where the other members of his or her group were sitting. Four confederates took part in the experiment to make up for last-minute subject withdrawal, and their responses were excluded from the analysis. Similar to Study 1, variation in sibling composition was lower in the present study sample relative to that of a larger representative sample of young Japanese adults (mean = 1.19).

3.1.2. Experimental design and procedure

The experiment was conducted in exactly the same manner as that of Study 1, with the exception of the following changes. First, in Study 2, subjects engaged in a math-solving, rather than maze-solving, task. Figure 4 shows a screenshot of the computer display.[9] In each task, subjects were asked to calculate the sums of 5 two-digit numbers within five minutes. They were not permitted to use a calculator; rather, they were provided with a pencil and pieces of scrap paper and asked to solve as many problems as possible within five minutes.

Second, in Study 2, subjects received cash rather than prizes, based on their performance in a randomly selected task. In the piece-rate payment scheme, subjects received 100 JPY (approximately 1 USD on July 16, 2014) for every correctly solved problem. In the tournament payment scheme, they received 400 JPY for every correctly solved problem if they solved the largest number of problems correctly within the group; otherwise, they received 0 JPY. All subjects received 2,000 JPY as a participation fee.

Finally, in Study 2, the piece-rate and tournament payment schemes were not repeated

[9] This type of experiment can also be programmed by the free software, Z-tree (Fischbacher, 2007).

(as in Tasks 3 and 4 in Study 1). In particular, upon completion of the practice session, the subjects engaged in math-solving tasks and were awarded points via the piece-rate (Task I) and then under a tournament payment scheme (Task II); thereafter, prior to solving further math problems, they were asked to choose the payment scheme via which they would receive points for the task (Task III, corresponding to Task 5 in Study 1). In the final task (Task IV, corresponding to Task 6 in Study 1), subjects were asked to choose the payment scheme via which they would receive points for their performance in Task I, originally the piece-rate task. They did not actually solve any problems in the final task, as in Study 1.

3.2. Results

Figure 5 shows the proportion of subjects who chose to enter the tournament payment scheme in Task III according to sex and sibling constellation. Subjects could belong to more than two of the categories shown in Figure 5, if they had more than two siblings (e.g., if both ‘has younger sisters’ and ‘has older sisters’ applied). Compared to Study 1, the overall rates of tournament scheme entry were lower for both men and women, respectively, in Study 2. The mean tournament scheme entry rates were 61% for men and 23.4% for women in Study 1 and 42.6% for men and 18.2% for women in Study 2 (see Table A1 in supplementary appendices for summary statistics). However, when we considered tournament scheme entry according to sibling constellation, a consistent pattern was observed. Similar to Study 1, only 24% of males with an older sister chose the tournament, while 48% of the rest of the men did. Interestingly, women with older sisters showed relatively high rates of competitive choice. The tournament scheme entry rate was 30% for women with older sisters, which was significantly higher than that of other women (two-tailed t test: $p = 0.065$, Cohen’s $d = 0.35$). In contrast, fewer women with a younger brother entered the tournament scheme in Study 2 relative to those in Study 1. Only 13.3% chose to compete, which is rather low relative to the average tournament scheme entry rate for women (18.2%).

Figure 6 confirms that the insights shown in Figure 5 were maintained, even after controlling for several confounding factors.[10] Similar to the results of Study 1, having an older sister exerted a significant effect on competitive preference in younger siblings. When the covariates were controlled for, men with an older sister were 21% less likely to enter the tournament scheme relative to the remainder of the men (p = 0.02). Interestingly, women with an older sister were 29% more likely to enter the tournament scheme relative to the remainder of the women (p = 0.02). The latter effect was close in size to the estimated negative effect of being a woman on tournament scheme entry (-36%).[11] Therefore, roughly speaking, women with an older sister behaved more like average men, rather than average women, in terms of competition preference. However, unlike the findings of Study 1, having a younger brother exerted a negative effect on women's competition decisions, although this was nonsignificant (p = 0.26).

4. Discussion

This study explored the effect of sibling constellation on an important personality trait, preference for competition, from the perspective of experimental economics. We analyzed a dataset obtained via simple laboratory experiments, similar to that designed by Niederle and Vesterlund (2007), on Japanese high school and university students, who were incentivized with pecuniary rewards.

Although this was not the first study to examine birth order effects via economics experiment (Courtiol, Raymond, & Faurie, 2009), no previous psychology studies have determined preference for competition via actual behavioral responses in an incentivized

[10] The detailed estimation results for Figure 6 are presented in Table B2 in the supplementary appendices.
[11] The estimate for being a woman is presented in the first row of Model 6 in Table B2 (supplementary material).

environment or purged the confounding factors that could correlate with the personality trait itself.[12] For instance, the decision to enter a competitive environment is influenced by many factors other than competitive preference, such as original performance level or risk-taking preference. By taking advantage of the experimental design originally proposed by Niederle and Vesterlund (2007), our studies controlled for these covariates and determined whether the competitive trait could be enhanced by a particular sibling structure.

Despite the fact that subjects engaged in completely different tasks in the two experiments, we observed some consistent patterns. First, the experiments showed that men were significantly more likely to choose to compete relative to women. This is consistent with the findings of Neiderle and Vesterlund (2007) and classifications established by Brim (1958), in which competitiveness was treated as a masculine trait. Second, we found that older sisters significantly influenced their younger rivals in both studies. In particular, having an older sister was *negatively* associated with men's competitive preference in both studies (Figures 3 and 6). This systematic pattern arose as a result of preference for competition rather than confounding factors such as performance level or risk preference. Interestingly, having an older sister was *positively* associated with women's competitive preference, although this relationship was significant only in Study 2. Finally, the effects of the sex of younger siblings were sensitive across studies. We did not find consistent evidence to suggest that women with younger brothers were more competitive.

One interesting finding was that having an older sister exerted a negative effect on preference for competition in men, but the effect was not observed in those men with an older brother or a younger sister. This is consistent with both Brim's (1958) role assimilation theory

[12] Courtiol et al. (2009) examined the relationship between birth order and trust/reciprocity in an economics experiment. Although they found that firstborns were less trustful relative to laterborns and only children, the amount of money the first player sends to the second player, which they used as a measure of trustworthiness, also reflects the extent to which the first player tolerates the risk that the second player would send nothing back.

and Sulloway's (1996) birth order theory. Specifically, birth order theory alone cannot explain our results, as men with an older brother would be expected to possess the laterborn tendencies found in those with an older sister, which was not observed in our studies. Similarly, Brim (1958)'s role assimilation theory alone cannot explain our results, as men with a younger sister would be expected to possess the feminine, less competitive, traits found in those with an older sister, which was not observed in our studies. Therefore, a combination of the two theories reflected the asymmetric effect of older sisters on younger brother's weak preference for competition.

Another suggestive but interesting finding in our studies was that having a same-sex older sibling increased preference for competition, although this was only statistically significant in one sibling constellation (i.e., women with older sisters in Study 2). Same-sex siblings share similar interests and family resource concerns; therefore, they are more likely to encounter conflict. In fact, Daly, Wilson, Salmon, Hiraiwa-Hasegawa, and Hasegawa (2001) examined official statistics regarding siblicide in several countries and found that it is observed far more frequently in same-sex siblings.

While same-sex sibling competition may explain our result in part, it should also be noted that this is incongruent with a prediction of Brim's (1958) role-assimilation theory as applied to women. Brim (1958) observed that girls in same-sex female dyads showed stronger sex-typed traits and were less competitive relative to girls in male-female dyads. One reason for this discrepancy could be that our sample consisted of Japanese high school and college students of the 2000s, whereas Brim's (1958) sample consisted of five- and six-year-olds in mid-twentieth-century Chicago. Cultural and social backgrounds and expected gender roles could differ too much between the two samples to allow for detection of persistent behavioral patterns.

Finally, our experiment was subject to methodological limitations that should be addressed in future research. First, we did not collect information regarding the age gaps between subjects and their siblings, despite the fact that the literature suggests that the birth order effect is best detected in siblings who are three to five years apart in age (Sulloway, 1996). Second, it should be noted that both study samples were not cleanly representative of young Japanese people, as our subjects had fewer siblings than average and were therefore more likely to be singleton sons or daughters relative to average students in the population. The academic achievements of the subjects in Study 2 were disproportionately high, as the entrance examination for Osaka University is one of the most selective of all Japanese universities. For this reason, we may have inadvertently selected students who preferred competition. If the competitive students were spread unevenly across sibling constellations, our estimates could have been biased. Last, and most importantly, some of our tests were underpowered due to the small sample size. Therefore, we might have failed to reject the null too often when the alternative was true (i.e., large type II error). We should add the caveat that the insignificant estimates observed for some sibling constellations might have been the product of a relatively underpowered test that bears replication with larger samples.

Acknowledgments

We are grateful to Yukiko Abe, Peter Kuhn, Edward Lazear, Hodaka Morita, Hideo Owan, Masaru Sasaki, Kathryn Shaw, Masaki Narukawa, Kai Hiraishi, and the participants at the 2012 Trans-Pacific Labor Seminar in Hawaii for their helpful comments. Any existing errors are our own. We also thank Kiyoko Murahima and Shizuka Yamagiwa for their assistance. The authors acknowledge research grants from the Japan Society for the Promotion of Science and Osaka University. Okudaira acknowledges grants from JSPS Postdoctoral Fellowship for Research Abroad and Okayama University.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

Adler, A. (1928). Characteristics of the first, second, and third child. *Children, 3,* 14-25.

Azmitia, M., & Hesser, J. (1993). Why siblings are important agents of cognitive development: A comparison of siblings and peers. *Child Development, 64,* 430-444

Beck, E., Burnet, K. L., & Vosper, J. (2006). Birth-order effects on facets of extraversion. *Personality and Individual Differences, 40,* 953-959.

Booth, A. L., Cardona-Sosa L., & Nolen, P. (2014). Gender differences in risk aversion: Do single-sex environments affect their development? *Journal of Economic Behavior and Organization, 99,* 126-154.

Brim, O. G. Jr. (1958). Family structure and sex role learning by children: A further analysis of Helen Koch's data. *Sociometry, 21,* 1-16.

Buser, T., Niederle, M., & Oosterbeek, H. (2014). Gender, competitiveness, and career choices. *The Quarterly Journal of Economics, 129,* 1409-1447

Courtiol, A., Raymond, M., & Faurie, C. (2009). Birth order affects behavior in the investment game: Firstborns are less trustful and reciprocate less. *Animal Behaviour, 78,* 1405-1411.

Dai, X., & Heckman, J. J. (2013). Older siblings' contributions to young child's cognitive skills. *Economic Modelling, 35,* 235-248.

Daly, M., Wilson, M., Salmon, C. A., Hiraiwa-Hasegawa, M., & Hasegawa, T. (2001). Siblicide and seniority. *Homicide Studies, 5,* 30-45.

Ernst, C., & Angst, J. (1983). *Birth order: Its influence on personality*. Berlin: Springer-Verlag.

Fischbacher, U. (2007). z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics, 10,* 171-178.

Fletcher, T. D., & Nusbaum, D. N. (2008). Trait competitiveness as a composite variable: Linkages with facets of the big-five. *Personality and Individual Differences, 45,* 312-317.

Gneezy, U., Leonard, K. L., & List, J. A. (2009). Gender differences in competition: Evidence from a matrilineal and a patriarchal society. *Econometrica, 77,* 1637-1664.

Healey, M. D., & Ellis, B. J. (2007). Birth order, conscientiousness, and openness to experience: Tests of the family-niche model of personality using a within-family methodology. *Evolution and Human Behavior, 28,* 55-59.

Houston, J. M., McIntire, S. A., Kinnie, J., & Terry, C. (2002). A factorial analysis of scales measuring competitiveness. *Educational and Psychological Measurement, 62,* 284-298.

Jefferson, T., Herbst, J. H., & McCrae, R. R. (1998). Associations between birth order and personality traits: Evidence from self-reports and observer ratings. *Journal of Research in Personality, 32,* 498-509.

Koch, H. L. (1954). The relation of “primary mental abilities” in five- and six-year olds to sex of child and characteristics of his sibling. *Child Development, 25,* 209-223.

Koch, H. L. (1955a). Some personality correlates of sex, sibling position, and sex of sibling among five- and six-year-old children. *Genetic Psychology Monographs, 52,* 3-50.

Koch, H. L. (1955b). The relation of certain family constellation characteristics and the attitudes of children toward adults. *Child Development, 26,* 13-40.

Koch, H. L. (1956a). Attitudes of young children toward their peers as related to certain characteristics of their siblings. *Psychological Monographs, 70,* 1-41.

Koch, H. L. (1956b). Children's work attitudes and sibling characteristics. *Child*

Development, 27, 289-310.

Koch, H. L. (1956c). Sibling influence on children's speech. *Journal of Speech and Hearing Disorders, 21,* 322-328.

Koch, H. L. (1956d). Sissiness and tomboyishness in relation to sibling characteristics. *Journal of Genetic Psychology, 88,* 231-244.

Longstreth, L. E., Longstreth, G. V., Ramirez, C., & Fernandez, G. (1975). The ubiquity of big brother. *Child Development, 46,* 769-772.

Marini, V., & Kurtz, J. E. (2011). Birth order differences in normal personality traits: Perspectives from within and outside the family. *Personality and Individual Differences, 51,* 910-914.

Maynard, A. E. (2002). Cultural teaching: The development of teaching skills in Maya sibling interactions. *Child Development, 73,* 969-982.

Mizutani, N., Okudaira, H., Kinari, Y., & Ohtake, F. (2009). Overconfidence makes men compete more (Jishinkajyo ga dansei wo kyoso saseru). *Journal of Behavioral Economics and Finance (Kodo Keizaigaku), 2,* 60-73. [in Japanese]

Niederle, M., & Vesterlund, L. (2007). Do women shy away from competition? Do men compete too much? *The Quarterly Journal of Economics, 122,* 1067-1101.

Perkin, M. R. (2003). Football position and atopy—both subject to the birth order effect? *British Medical Journal, 327,* 1473.

Paulhus, D. L., Trapnell, P. D., & Chen, D. (1999). Birth order effects on personality and achievement within families. *Psychological Science, 10,* 482-488.

Salmon, C. A. (1999). On the impact of sex and birth order on contract with kin. *Human Nature, 10,* 183-197.

Salmon, C. A. (2003). Birth order and relationships, family, friends, and sexual partners. *Human Nature, 14,* 73-88.Salmon, C. A., & Daly, M. (1998). Birth order and familial

Yamamura, E. (2014). Effects of siblings and birth order on income redistribution preferences: Evidence based on Japanese general social survey. *Social Indicators Research*. DOI 10.1007/s11205-014-0649-z.205-014-0649-z.

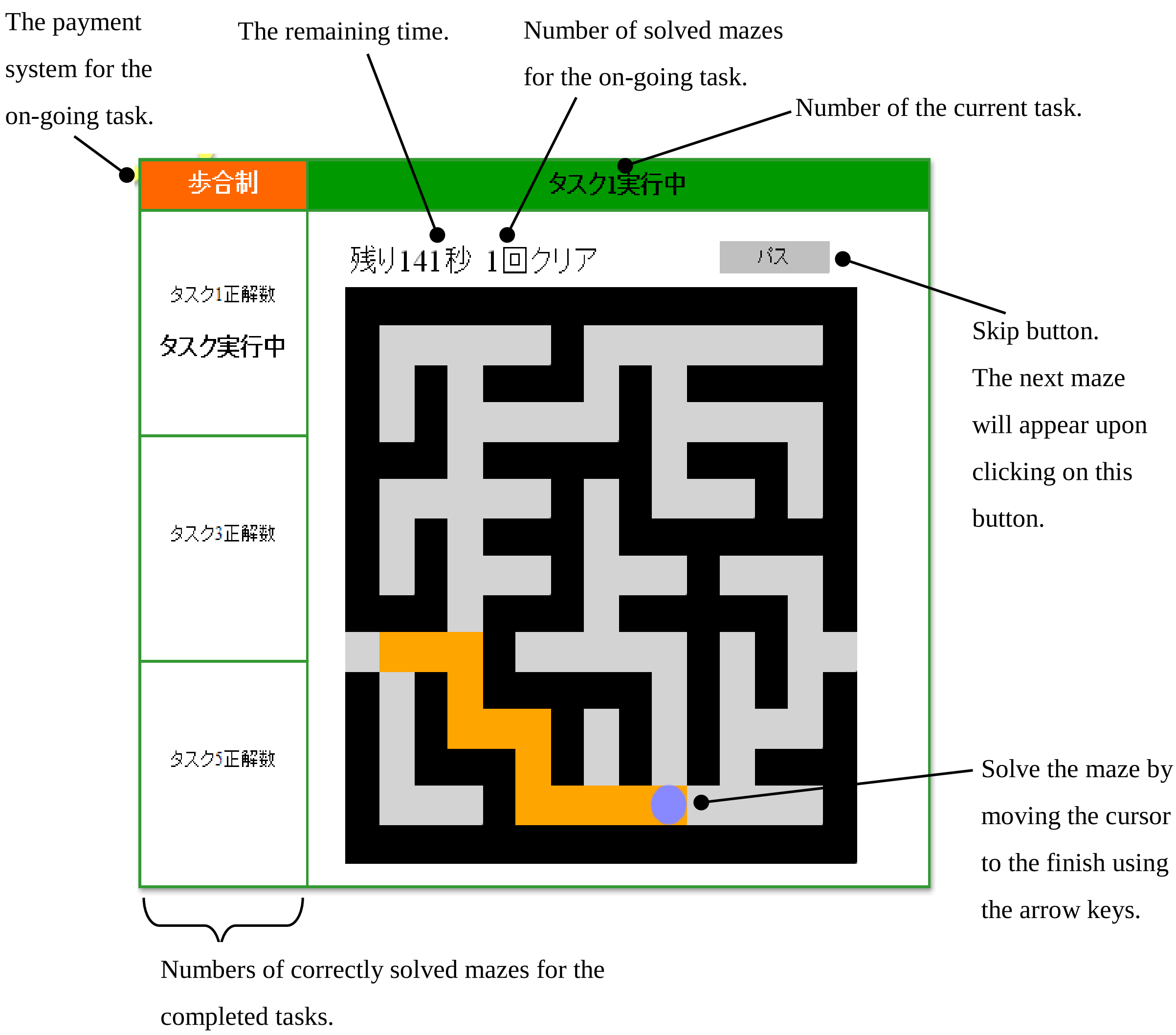

Figure 1. Overview of Basic Screen (Study 1)

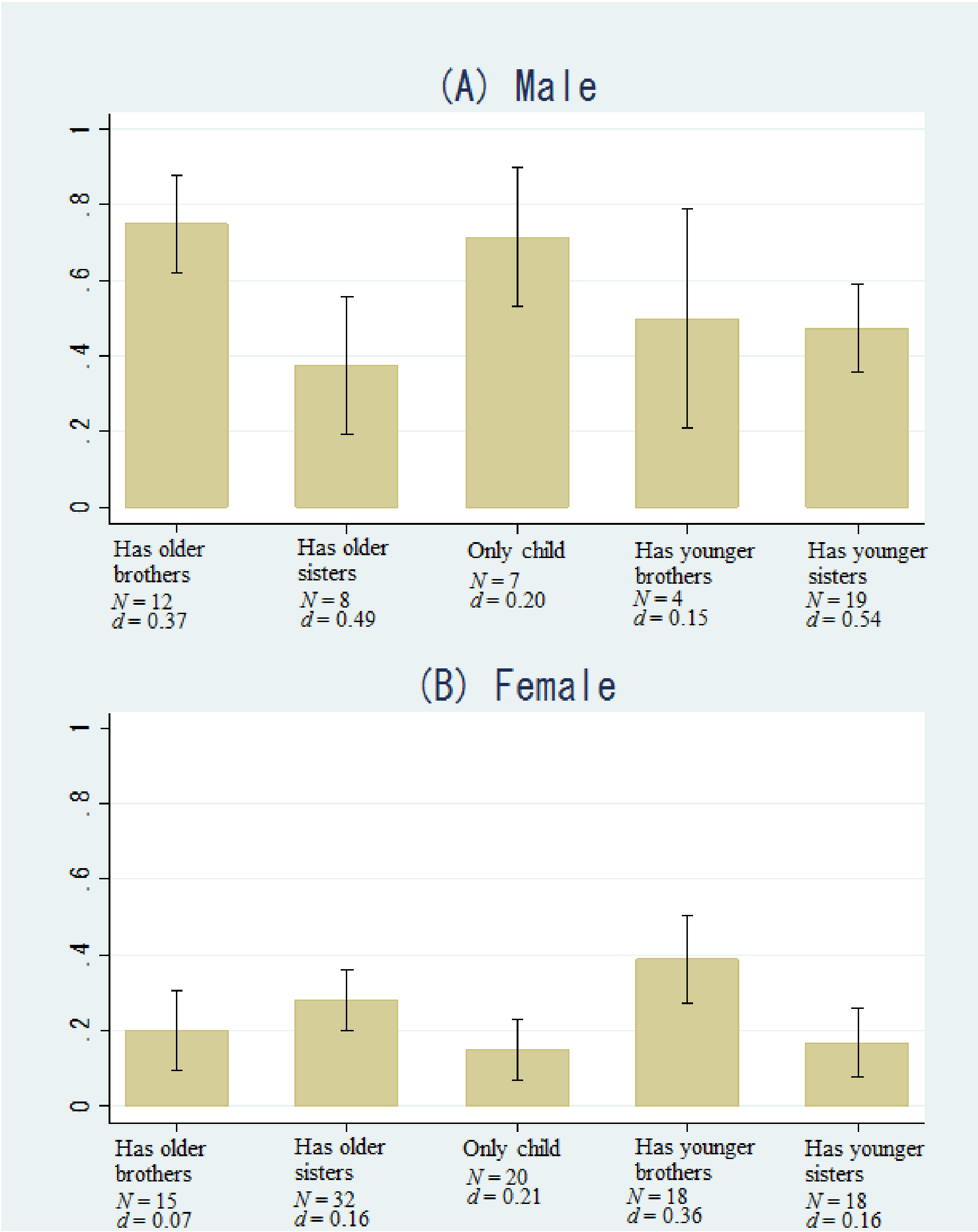

Figure 2. Proportion of participants who chose to compete in Task 5 (Study 1)

Note. Capped spikes represent standard errors. *d* indicate an absolute value of Cohen's *d*, where the effect size is estimated in a mean difference test between the sibling constellation and the rest of men/women. In panel (A), a mean difference between men who have older sisters (mean = 0.38, N = 8) and the rest of men (mean = 0.67, N = 33) is 0.29 (two-tailed t test: p = 0.14, Cohen's d = 0.49). In panel (B), a mean difference between women who have younger brothers (mean = 0.39, N = 18) and the rest of women (mean = 0.20, N = 76) is 0.19 (two-tailed t test: p = 0.086, Cohen's d = -0.36).

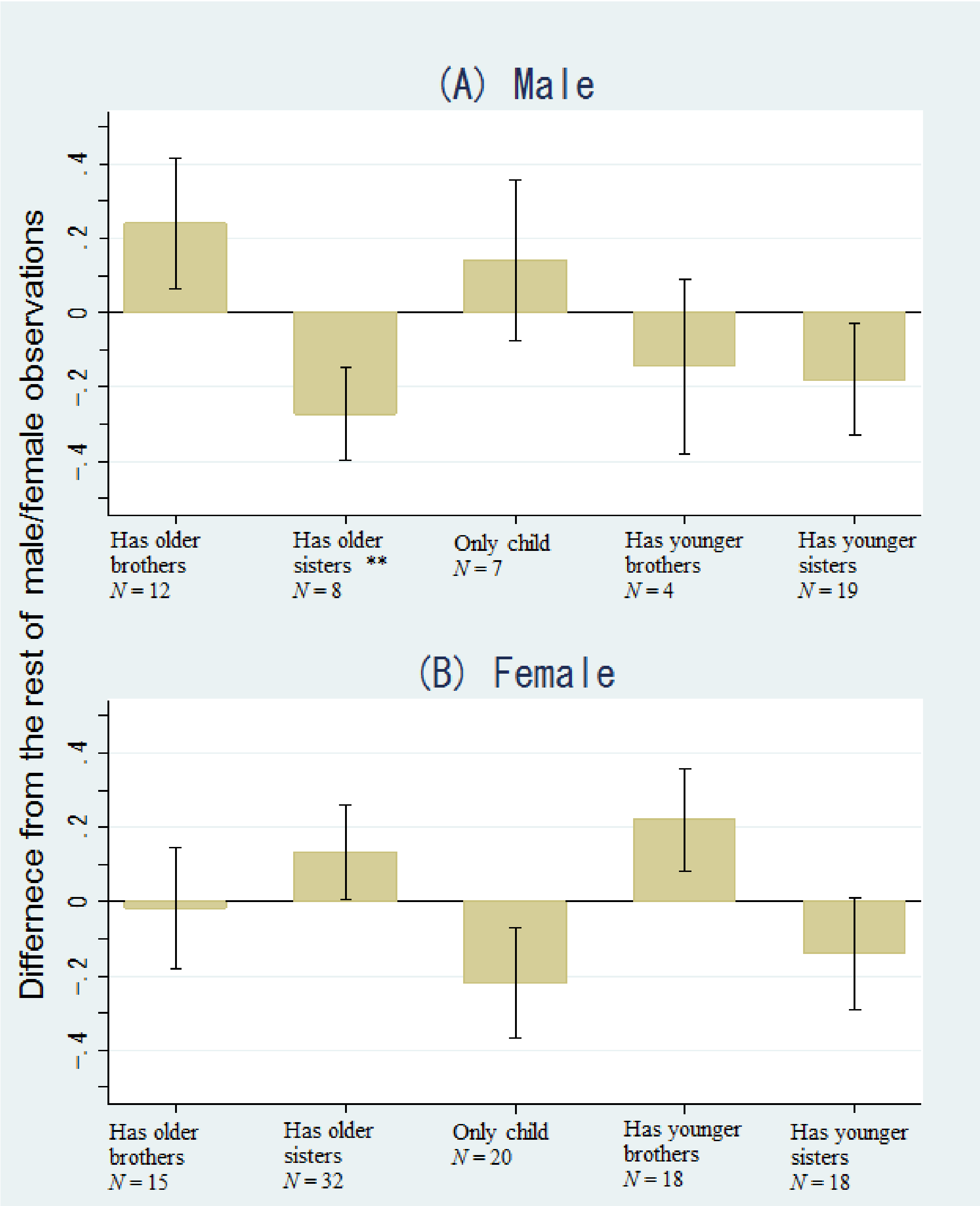

Figure 3. Preference for Competition (Study 1)

Note. The bars indicate the estimated marginal effects on the probability to enter the tournament in comparison to the rest of male/female observations. Positive values indicate that a subject has the higher preference for competition than the rest of male/female observations do, while negative values indicate the opposite. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Capped spikes represent standard errors. Each estimate is from Models 3 to 7 in Table B1, and only the estimates for sibling constellation variables are shown in the figure. Since the vertical axis measures the difference from the rest of men or women, bars are not directly comparable across sibling constellation groups.

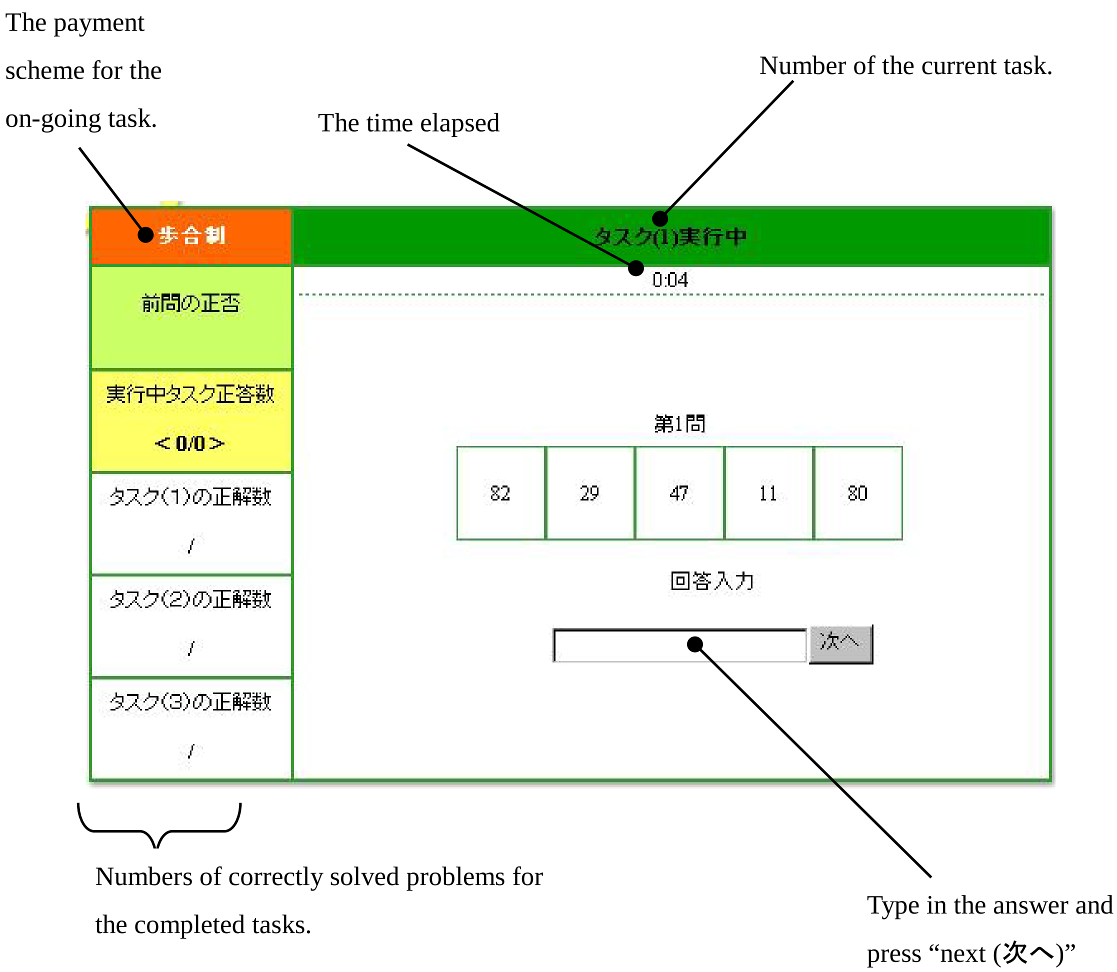

Figure 4. Overview of Basic Screen (Study 2)

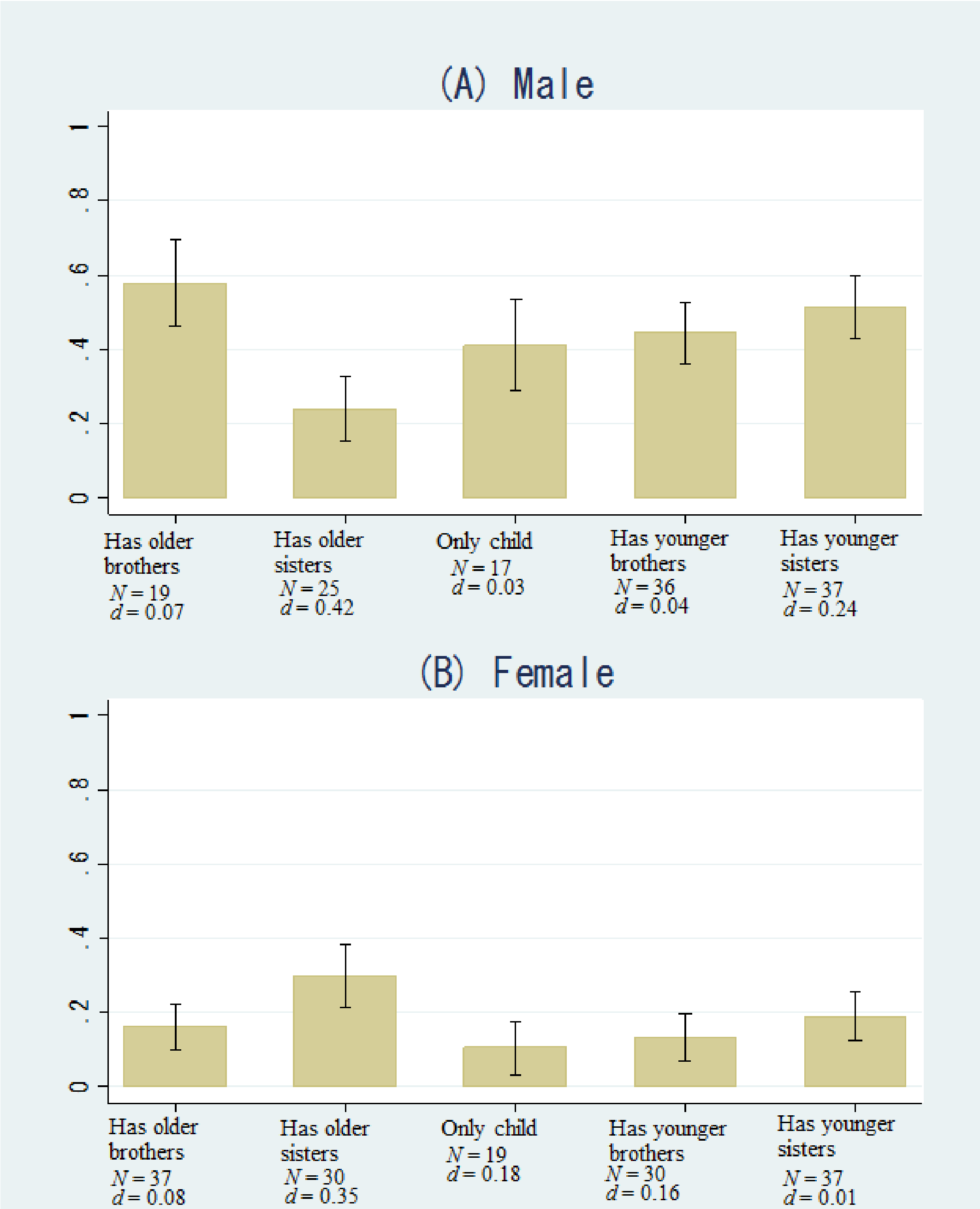

Figure 5. Proportion of participants who chose to compete in Task III (Study 2)

Note. Capped spikes represent standard errors. *d* indicate an absolute value of Cohen's *d*, where the effect size is estimated in a mean difference test between the sibling constellation and the rest of men/women. In panel (A), a mean difference between men who have older sisters (mean = 0.24, N = 25) and the rest of men (mean = 0.48, N = 89) is 0.24 (two-tailed t test: p = 0.03, Cohen's d = 0.42). In panel (B), a mean difference between women who have older sisters (mean = 0.30, N = 30) and the rest of women (mean = 0.15, N = 88) is -0.15 (two-tailed t test: p = 0.07, Cohen's d = -0.35).

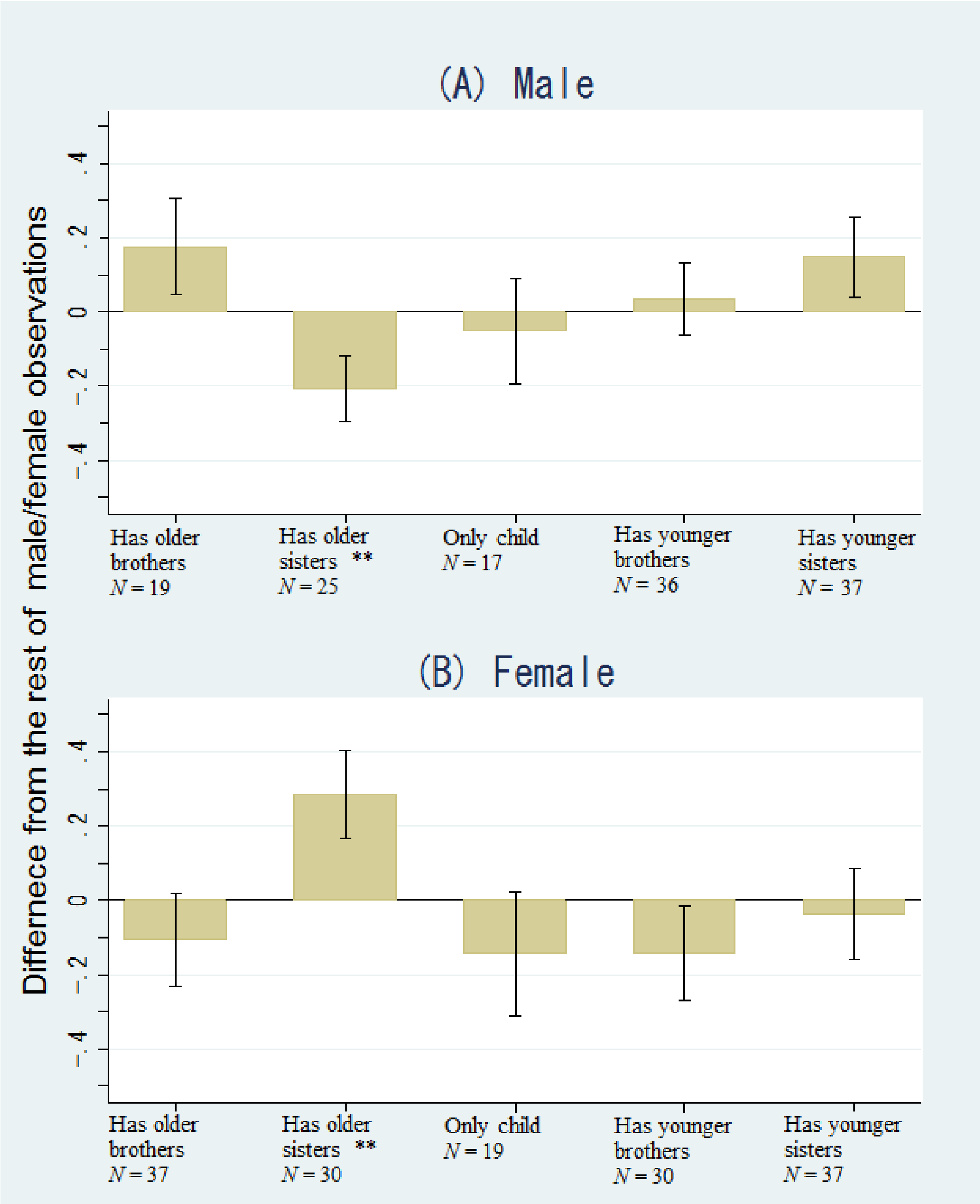

Figure 6. Preference for Competition (Study 2)

Note. The bars indicate the estimated marginal effects on the probability to enter the tournament in comparison to the rest of male/female observations. Positive values indicate that a subject has the higher preference for competition than the rest of male/female observations do, while negative values indicate the opposite. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Capped spikes represent standard errors. Each estimate is from Models 3 to 7 in Table B2, and only the estimates for sibling constellation variables are shown in the figure. Since the vertical axis measures the difference from the rest of men or women, bars are not directly comparable across sibling constellation groups.