Strategic Thinking Skills: A Key to Collective Economic Success

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Online Appendix

A1. Experimental Instructions and Sample Screen Shots

Full Instructions and Selected Screen Shots

- English Version: https://www.dropbox.com/s/0i14kps23rrgqtp/Instructions_Screens_ENGLISH.pdf?dl=0
- Chinese Version: https://www.dropbox.com/s/9bfzle8sgn54xey/Instructions_Screens_CHINESE.pdf?dl=0

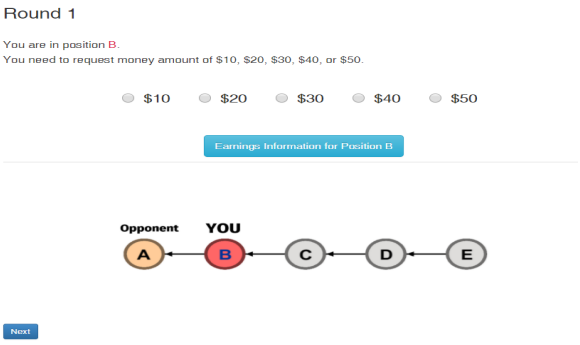


Figure A1. : Line game - position B

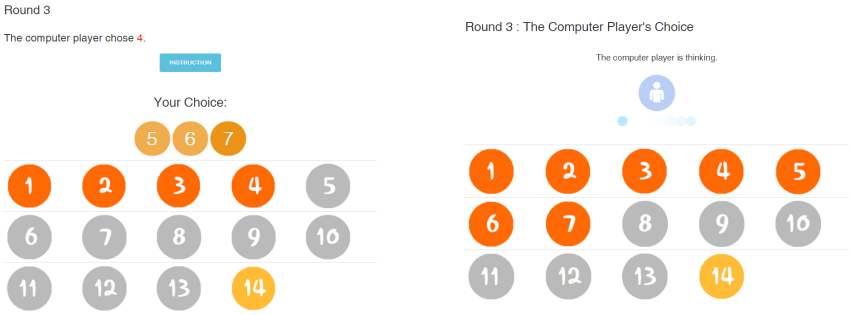


Figure A2. : Lift game with target number 14

A2. The Distributions of Strategic Thinking Skills by Gender

Table A1—: Distribution of the HOR scores by gender

Panel A: Male							
Data	Min	10th	25th	50th	75th	90th	Max
SLP	23.9	37.8	41.2	49.0	65.4	68.6	72.6
KLIPS	21.5	37.2	40.3	48.3	56.5	64.5	66.7
Panel B: Female							
Data	Min	10th	25th	50th	75th	90th	Max
SLP	23.9	38.3	41.9	49.9	66.4	68.6	72.6
KLIPS	21.5	35.7	39.7	46.9	53.1	63.4	67.6

Table A2—: Distribution of the BI score by gender

Score	1	2	3	4	5
Panel A: Male					
SLP	41.2%	33.1%	21.7%	2.0%	1.9%
KLIPS	39.0%	36.5%	18.0%	2.8%	3.9%
Panel B: Female					
SLP	42.1%	36.2%	17.8%	2.1%	1.8%
KLIPS	41.0%	37.0%	17.2%	0.7%	4.0%

A3. SLP Summary Statistics

Table A3—: SLP sample characteristics by participation status

	(1) Participants Mean (SD)	(2) Dropouts Mean (SD)	(3) Nonparticipants Mean (SD)
Age	58.5	58.5	58.3
	(3.62)	(3.54)	(3.63)
Male	0.49	0.46	0.48
	(0.50)	(0.50)	(0.50)
Chinese	0.91	0.86	0.87
	(0.29)	(0.35)	(0.34)
Married	0.82	0.76	0.83
	(0.38)	(0.43)	(0.37)
Number of children	2.86	2.76	2.90
	(1.09)	(1.16)	(1.12)
Postsecondary education	0.45	0.45	0.36
	(0.50)	(0.50)	(0.48)
IST Score	10.83	9.23	9.47
	(4.08)	(4.15)	(4.14)
Financial planning horizon longer than the next 5 years	0.50	0.45	0.43
	(0.50)	(0.50)	(0.50)
Risk tolerance	3.72	3.73	3.35
	(2.47)	(2.43)	(2.42)
Self-efficacy	14.7	14.5	14.3
	(2.52)	(2.78)	(2.45)
Personal optimism	13.2	13.1	12.9
	(2.59)	(2.57)	(2.37)
Proportion (own annual labor income > 0)	0.70	0.70	0.70
	(0.46)	(0.46)	(0.46)
Own annual labor income (excl. zero's)	50,283	51,359	41,863
	(63,824)	(70,355)	(50,680)
Own annual labor income (incl. zero's)	35,264	36,032	29,122
	(58,190)	(63,431)	(46,447)
Proportion (spouse's annual labor income > 0)	0.52	0.47	0.51
	(0.50)	(0.50)	(0.50)
Spouse's annual labor income (excl. zero's)	47,199	40,126	44,516
	(56,946)	(47,329)	(55,524)
Spouse's annual labor income (incl. zero's)	29,982	24,789	26,869
	(50,752)	(41,989)	(48,309)
Observations	2,146	641	808

Note: This table presents statistics based on cross-sectional data of different waves but mainly on the August 2017 survey. Monetary variables are in 2016 Singapore dollars.

A4. Data Appendix

- Intelligence Structure Test
  - We use the Intelligence Structure Test (IST) as a measure of IQ. The IST is an internationally used, popular cognitive ability test originally developed by Beauducel et al. (2010). It is similar to the Raven's Matrices test in the sense that both tests use figural matrices to assess an individual's cognitive ability without requiring verbal intelligence.
  - There are 20 figural questions, each of which contains a matrix of abstract figures with a missing part. A participant needs to choose one of five figures presented to guess the missing part. A sample question is presented below in Figure A3.
  - The first version of the IST was developed in 1953 and has been regularly updated. The current English version we use is updated in 2000. We define the IST score as the number of correct answers to 20 questions. In our study, the experiment participants in Singapore scored 10.8 on average, with male respondents scoring 11.0 and female respondents scoring 10.6. According to the authors of the IST, the German sample participants scored 9.6 on average (Beauducel et al., 2010).

- Reading the Mind in the Eyes Test (Eyes Test)
  - This test was originally developed by Simon Baron-Cohen and his research team as "a test of how well the participant can put themselves into the mind of the other person, and tune in to their mental state" (Baron-Cohen et al., 2001). They find that individuals with autism or Asperger syndrome perform significantly worse than others in this test. Figure A4 presents a sample question. In the original version of the Eyes Test, there are 36 questions. Each question shows a picture of human eyes area and asks the respondent to choose the word that best describes what the person in the picture is thinking or feeling. We use a simpler version of the test, often used for children in the literature, that has 28 questions only and uses easier vocabulary for the descriptions of possible mental states in each picture following the recommendation of Olderbak et al. (2015).
  - We implemented the Eyes Test in both the SLP and the KLIPS. We obtained a well-shaped empirical distribution presented in Table A4, with a mean score of 19.8 and a standard deviation of 3.46 in the SLP sample and a mean score of 19.3 and a standard deviation of 4.01 in the KLIPS sample. The mean Eyes Test scores of the SLP and KLIPS samples are similar to that of the adult sample in the original study (Baron-Cohen et al., 2001) after adjusting for the number of questions. Most studies of the Eyes Test in psychology were conducted on a small

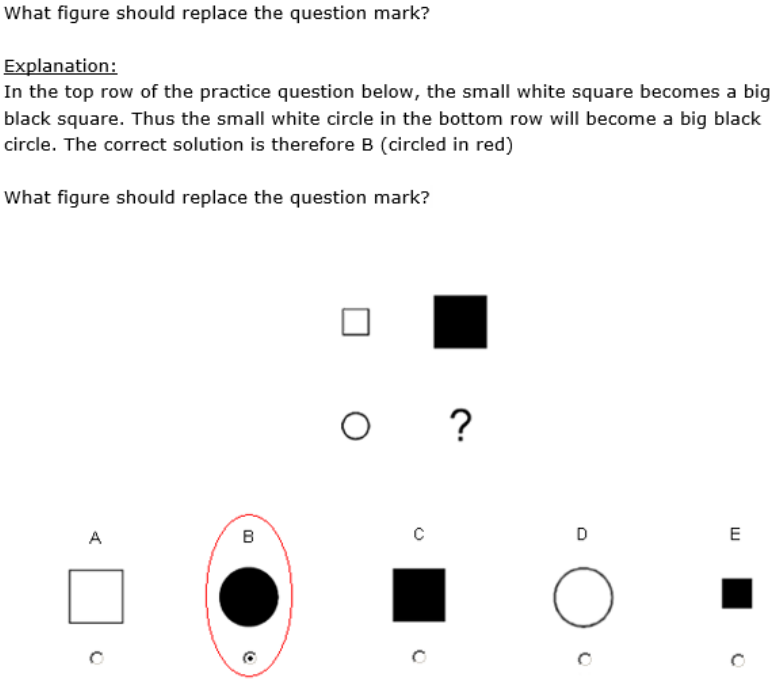


Figure A3. : IST sample question

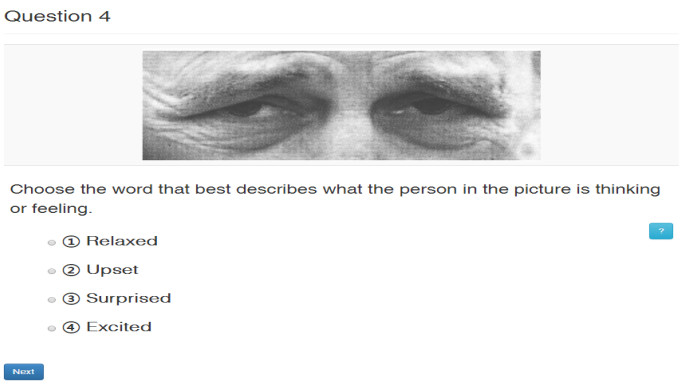


Figure A4. : Reading the mind in the Eyes Test – sample question

number of nonrepresentative samples with sample sizes smaller than 100 individuals. To our knowledge, this study is the first to implement the Eyes Test in a large-scale survey of a nationally representative population of over 2,000 individuals. We find little gender differences in the average Eyes test score.

Table A4—: Distribution of the Eyes Test score

Data	Min	10th	25th	50th	75th	90th	Max
SLP	4	15	18	20	22	24	28
KLIPS	3	14	17	20	22	24	27

- Time Horizon for Financial Planning
  - We measure the time horizon for financial planning using a response to the following question.
    - *In planning your (family's) saving and spending, which of the following time periods is most important to [you/you and your spouse]?*
      1) the next few months
      2) the next year
      3) the next few years
      4) the next 5-10 years
      5) longer than 10 years
- Risk Tolerance
  - We use a subjective response to the following question as a measure of risk tolerance.
    - *Are you generally a person who tries to avoid taking risks or one who is fully prepared to take risks? Please rate yourself from 0 to 10, where 0 means 'not at all willing to take risks' and 10 means 'very willing to take risks'.*
- Personal Optimism and Self-efficacy
  - Personal optimism is defined as a person's expectation that outcomes will be positive regardless of what caused a problem or a situation. Self-efficacy is a positive belief that a person is able to solve the problem (**?**). To measure personal optimism and self-efficacy, we use the abridged version of *the Questionnaire for the Assessment of Personal Optimism and Social Optimism - Extended* (POSO-E). The POSO-E is originally developed by **?**. We use a shortened version of the POSO-E scales by **?**. The scales are based on subjective responses to the following 8 items. A respondent can rate how agreeable s/he is on a scale of 1 to 5, where 1 indicates strongly disagree and 5 indicates strongly agree.
    1) For each problem I will find a solution.
    2) In difficult situations I will find a way.

3) I am facing my future in an optimistic way.
4) I can hardly think of something positive in the future.*
5) I can master difficulties.
6) I worry about my future.*
7) I always find a solution to a problem.
8) It often seems to me that everything is gloomy.*

– Items 1, 2, 5, and 7 reflect self-efficacy. Items 3, 4, 6, and 8 reflect personal optimism. * indicates reverse-coded items.

A5. Summary Statistics of the KLIPS Sample

Our baseline sample is 50–65 years old Singaporeans. Hence, it would be useful to check whether our findings on the strategic thinking skill measures can be externally validated in other countries and other age groups. We implemented the same survey experiments on a randomly chosen small sample of the Korea Labor Income Panel Study (KLIPS), which surveys a nationally representative sample of urban Korean households.[1] Thus, it provides an opportunity to test whether the observed patterns of strategic thinking skills from the SLP sample are similar in other countries and other age groups. Table A5 reports the summary statistics of the KLIPS sample.

Table A5—: Summary statistics of the KLIPS sample

Variable	Mean (SD)
Ages 30-39	0.24 (0.43)
Ages 40-49	0.33 (0.47)
Ages 50-59	0.19 (0.39)
Ages 60-69	0.10 (0.30)
Ages 70-79	0.03 (0.18)
Male	0.46 (0.50)
Married	0.88 (0.32)
Number of children	1.02 (0.99)
Postsecondary education	0.49 (0.50)
Risk Tolerance	4.03 (1.39)
Impulsivity	3.65 (1.44)
Big 5 Personality: Openness	12.49 (3.22)
Big 5 Personality: Conscientiousness	6.62 (2.81)
Big 5 Personality: Extraversion	6.37 (3.02)
Big 5 Personality: Agreeableness	6.31 (2.63)
Big 5 Personality: Neuroticism	12.07 (2.67)
Individual annual labor income	3,752 (10,358)
Spouse's annual labor income	3,872 (14,671)
Weekly hours of wage workers (weekly)	40.81 (9.08)
Hourly wages of wage workers	1.50 (1.29)
Observations	786

Note: This table presents statistics based on cross-sectional data of different waves but mainly on Wave 25 (2017). Monetary variables are in 2015 10,000 Korean Won.

[1]The KLIPS can be roughly considered as the Korean version of the U.S. Panel Study of Income Dynamics (PSID). The details of the KLIPS can be found at https://www.kli.re.kr.

A6. Full Results of Annual Labor Income Regression

Tables A6 and A7 report the regression results reported in Table 4 with the coefficient estimates of all covariates, except for the experimental controls to save space. We acknowledge that the coefficient estimates of the education and cognitive ability variables reported are not statistically significantly estimated (except for the education dummy for females). However, as in the literature, we observe a large education-income gradient in the SLP data before controlling for individual characteristics. In addition, the magnitudes of the coefficient estimates are likely to be smaller than those estimated among prime-aged workers in other developed countries because our sample individuals are relatively older and thus the incremental impacts of additional education could have been dampened.

Table A6—: Regression of male labor income (full results)

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Inverse hyperbolic sine transformation of own annual labor income					
BI score	0.429***		0.375**		0.372**	
	(0.144)		(0.149)		(0.151)	
HOR Score (standardized)		0.681***		0.612**		0.580**
		(0.240)		(0.248)		(0.249)
Age 55-59	-0.195	-0.173	-0.152	-0.134	-0.164	-0.169
	(0.382)	(0.383)	(0.383)	(0.383)	(0.385)	(0.385)
Age 60-65	-1.261***	-1.252***	-1.198**	-1.196**	-1.104**	-1.195**
	(0.468)	(0.468)	(0.471)	(0.471)	(0.473)	(0.475)
Chinese	0.129	0.236	0.077	0.159	0.143	0.238
	(0.504)	(0.497)	(0.501)	(0.495)	(0.502)	(0.510)
Married	-1.216*	-1.228*	-1.258*	-1.279*	-1.132	-1.132
	(0.697)	(0.740)	(0.714)	(0.754)	(0.715)	(0.810)
Number of Children	-0.123	-0.100	-0.124	-0.104	-0.131	-0.086
	(0.145)	(0.146)	(0.146)	(0.146)	(0.146)	(0.147)
Spouse's age	-0.033	-0.035	-0.035	-0.037	-0.045	-0.041
	(0.032)	(0.032)	(0.031)	(0.032)	(0.031)	(0.032)
Missing spouse's age or nonmarried	-1.218	-1.122	-1.117	-1.035	-0.512	-0.611
	(1.646)	(1.670)	(1.635)	(1.659)	(1.626)	(1.705)
Tertiary education			0.264	0.232	0.152	0.136
			(0.299)	(0.297)	(0.303)	(0.303)
IST score			0.053	0.058	0.041	0.045
			(0.038)	(0.037)	(0.038)	(0.038)
Eyes Test Score (standardized)			-0.104	-0.174	-0.269	-0.178
			(0.372)	(0.376)	(0.372)	(0.380)
Financial planning horizon longer than the next 5 years					-0.142	-0.233
					(0.286)	(0.287)
Risk tolerance					0.059	0.058
					(0.063)	(0.063)
Self-efficacy					0.039	0.048
					(0.065)	(0.065)
Personal Optimism					0.056	0.051
					(0.065)	(0.065)
Constant	12.25***	12.36***	11.82***	11.93***	10.68***	11.21***
	(1.842)	(1.866)	(1.891)	(1.918)	(2.128)	(2.235)
Observations	1,044	1,044	1,044	1,044	1,044	1,044
R-squared	0.037	0.037	0.041	0.041	0.053	0.052

Note: Standard errors are corrected for heteroskedasticity. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

Table A7—: Regression of female labor income (full results)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Inverse hyperbolic sine transformation of own annual labor income					
BI score	-0.367**		-0.462***		-0.473***	
	(0.179)		(0.176)		(0.182)	
HOR Score		0.257		-0.031		-0.006
		(0.285)		(0.289)		(0.289)
Age 55-59	-0.113	-0.078	-0.129	-0.106	-0.056	-0.012
	(0.399)	(0.398)	(0.392)	(0.392)	(0.393)	(0.393)
Age 60-65	-2.277***	-2.258***	-2.173***	-2.153***	-2.165***	-2.098***
	(0.473)	(0.473)	(0.463)	(0.463)	(0.465)	(0.464)
Chinese	1.720***	1.612***	1.893***	1.828***	1.906***	1.832***
	(0.592)	(0.600)	(0.559)	(0.570)	(0.562)	(0.580)
Married	-0.980	-1.045	-1.339	-1.405	-1.152	-1.227
	(0.859)	(0.860)	(0.863)	(0.868)	(0.843)	(0.837)
Number of Children	-0.056	-0.074	0.098	0.076	0.123	0.075
	(0.149)	(0.149)	(0.149)	(0.149)	(0.152)	(0.151)
Spouse's age	0.027	0.032	0.036	0.040	0.039	0.046
	(0.039)	(0.040)	(0.038)	(0.038)	(0.038)	(0.038)
Missing spouse's age or nonmarried	-0.912	-1.103	-1.523	-1.676	-1.515	-1.863
	(1.708)	(1.721)	(1.651)	(1.670)	(1.641)	(1.653)
Tertiary education			1.810***	1.841***	1.480***	1.535***
			(0.331)	(0.333)	(0.348)	(0.347)
IST score			0.060	0.042	0.044	0.028
			(0.039)	(0.039)	(0.039)	(0.039)
Eyes Test Score (standardized)			0.722*	0.642*	0.705*	0.590
			(0.371)	(0.374)	(0.372)	(0.377)
Financial planning horizon longer than the next 5 years					-0.084	-0.087
					(0.309)	(0.311)
Risk tolerance					0.151**	0.161**
					(0.065)	(0.065)
Self-efficacy					0.110	0.120*
					(0.071)	(0.072)
Personal Optimism					0.086	0.080
					(0.070)	(0.071)
Constant	5.231**	4.705*	2.829	2.578	-1.109	-1.634
	(2.566)	(2.578)	(2.527)	(2.540)	(2.794)	(2.804)
Observations	1,102	1,102	1,102	1,102	1,102	1,102
R-squared	0.052	0.049	0.088	0.082	0.103	0.100

Note: Standard errors are corrected for heteroskedasticity. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

Table A8—: Regression of individual labor income on both BI and HOR measures of strategic thinking skills

Variables	(1)	(2)	(3)
	IHS-transformed own annual labor income		
	Panel A: Male		
BI score	0.372**		0.261*
	(0.151)		(0.159)
HOR score (standardized)		0.580**	0.486*
		(0.249)	(0.262)
Observations	1,044	1,044	1,044
R-squared	0.053	0.052	0.064
	Panel B: Female		
BI score	-0.473***		-0.510***
	(0.182)		(0.189)
HOR score (standardized)		-0.006	0.226
		(0.289)	(0.297)
Observations	1,102	1,102	1,102
R-squared	0.103	0.100	0.109
Demographics	Yes	Yes	Yes
Education and cognitive skills	Yes	Yes	Yes
Noncognitive and preference traits	Yes	Yes	Yes

Note: Standard errors are corrected for heteroskedasticity. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively. All columns demographic variables (age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, and the dummy variable reflecting a missing observation for spouse's age for single individuals), educational attainment, IST score, and Eyes Test score, noncognitive traits (financial planning time horizon, subjective risk tolerance, self-efficacy, personal optimism), time taken to complete corresponding tasks, the random order of the Line and Lift games.

A7. Quantile Regression Analysis of Annual Labor Income

Tables A9 and A10 report the coefficient estimates of respective male and female labor incomes across different quantiles of the distribution. The full set of control variables are included as in the mean regression analysis. Due to the significant sample size of zero labor income earners, we conduct the quantile regression analysis from the 20th percentile for male participants and from the 30th percentile for female participants.

Table A9—: Quantile regression results of male labor income

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Percentile	10th	20th	30th	40th	50th	60th	70th	80th	90th
					Panel A				
BI score		0.696	0.243	0.185	0.128**	0.077*	0.037	0.046	0.028
		(0.543)	(0.218)	(0.113)	(0.050)	(0.043)	(0.032)	(0.039)	(0.034)
Observations		1,044	1,044	1,044	1,044	1,044	1,044	1,044	1,044
Pseudo R-squared		0.092	0.037	0.030	0.036	0.044	0.055	0.070	0.087
					Panel B				
HOR score (standardized)		1.175	0.940**	0.283*	0.141	0.155**	0.137**	0.149***	0.119**
		(0.928)	(0.390)	(0.170)	(0.089)	(0.064)	(0.062)	(0.052)	(0.050)
Observations		1,044	1,044	1,044	1,044	1,044	1,044	1,044	1,044
Pseudo R-squared		0.102	0.038	0.029	0.034	0.043	0.053	0.068	0.087

Note: Heteroskedasticity-robust standard errors are reported in parentheses. The dependent variable is a respondent's own annual labor income transformed with the IHS function. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, the dummy variable reflecting a missing observation for spouse's age for single individuals, educational attainment, IST score, the Eyes Test score, financial planning time horizon, subjective risk tolerance, self-efficacy, personal optimism, and time taken to complete each task. Panels A and B include dummy variables for the random order of the Lift Game and the Line Game, respectively. ***, **, * denote $p<0.01$, $p<0.05$, $p<0.1$, respectively. The coefficient estimates on the 10th percentile are missing due to the lack of variations in the dependent variable.

Table A10—: Quantile regression results of female labor income

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Percentile	10th	20th	30th	40th	50th	60th	70th	80th	90th
					Panel A				
BI score			-0.826**	-0.758**	-0.371	-0.145	-0.112	-0.118**	-0.107*
			(0.407)	(0.297)	(0.259)	(0.109)	(0.075)	(0.050)	(0.058)
Observations			1,102	1,102	1,102	1,102	1,102	1,102	1,102
Pseudo R-squared			0.010	0.141	0.068	0.048	0.048	0.051	0.061
					Panel B				
HOR score (standardized)			0.027	0.085	0.062	0.039	-0.036	-0.248***	-0.082
			(0.443)	(0.365)	(0.331)	(0.173)	(0.130)	(0.088)	(0.063)
Observations			1,102	1,102	1,102	1,102	1,102	1,102	1,102
Pseudo R-squared			0.007	0.138	0.067	0.048	0.048	0.049	0.060

Note: Heteroskedasticity-robust standard errors are reported in parentheses. The dependent variable is a respondent's own annual labor income transformed with the IHS function. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, the dummy variable reflecting a missing observation for spouse's age for single individuals, educational attainment, IST score, the Eyes Test score, financial planning time horizon, risk tolerance, self-efficacy, personal optimism, and time taken to complete each task. Panels A and B include dummy variables for the random order of the Lift Game and the Line Game, respectively. ***, **, * denote $p<0.01$, $p<0.05$, $p<0.1$, respectively. The coefficient estimates on the 10th and 20th percentiles are missing due to the lack of variation in the dependent variable.

A8. Evaluating Explanatory Power

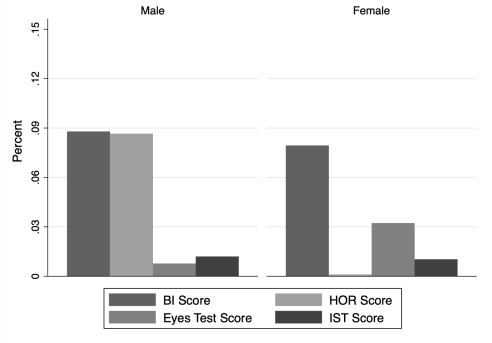
We investigate how much of the variation in labor market outcomes is explained by our measures of strategic thinking skills. First, we compute a partial R^2 of labor outcomes on our strategic thinking skill measures with the full set of control variables. We then normalize the variation in labor market outcome explained by each variable of interest by the total variation explained by the entire set of variables in this exercise. We also consider the cognitive ability measures (IST score and Eyes Test score) to compare with the explanatory power of the strategic thinking skill measures.

Figure A5 presents a graphical summary of the explanatory powers of the variables of interest for (a) individual labor income including zero-income earners, (b) individual labor income excluding zero-income earners, and (c) the proportion of individuals with a positive annual labor income.

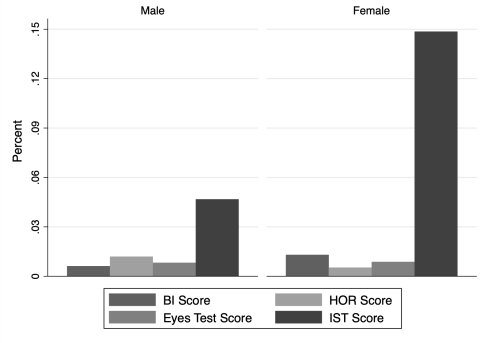
For male respondents, each of the BI and HOR scores contributes approximately 9 percent of the total explained variation in their own labor income (including the sample of zero-income earners), whereas the Eyes Test score and IST score contribute only marginally (Figure A5a). When we distinguish between the extensive margin and the intensive margin of labor supply for male respondents, we find that the relative explanatory power of the BI and HOR scores is mainly driven by their power to explain the variations in the extensive margin of labor supply (Figure A5c). Both the Eyes Test score and IST score have little ex-

planatory power for the extensive margin. When we focus only on the sample of respondents who earned positive labor income, however, strategic thinking skills contribute less than cognitive ability measured by the IST score (Figure A5b).

(a) Annual labor income (incl. 0s)



(b) Annual labor income (excl. 0s)



(c) 1{labor income > 0}

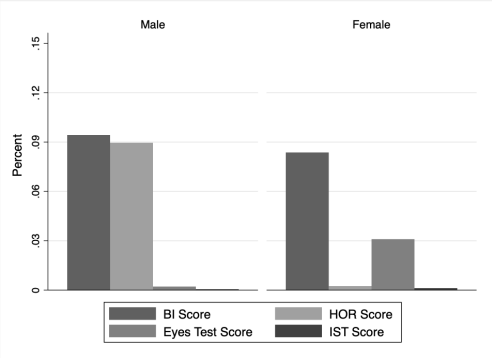


Figure A5. : Comparing explanatory power for individual labor market outcomes

For female respondents, the BI score contributes the most, approximately 8 percent, to the total explained variation in their own labor income (including the sample of zero-income earners), while the Eyes Test score contributes approximately 3 percent (Figure A5a). The explanatory power of these two measures originates mostly from their ability to explain the extensive margin of the female labor supply (Figure A5c). The IST score has substantial explanatory power in explaining the variation in labor income when the sample of zero-income earners is excluded (Figure A5b).

A9. Additional Analysis of Annual Labor Income

Figures A6, A7, and A8 presents the mean and the 95 percent confidence intervals of annual labor income (including zero), a dummy variable of positive labor income, annual labor income (excluding zero) by gender, respectively.

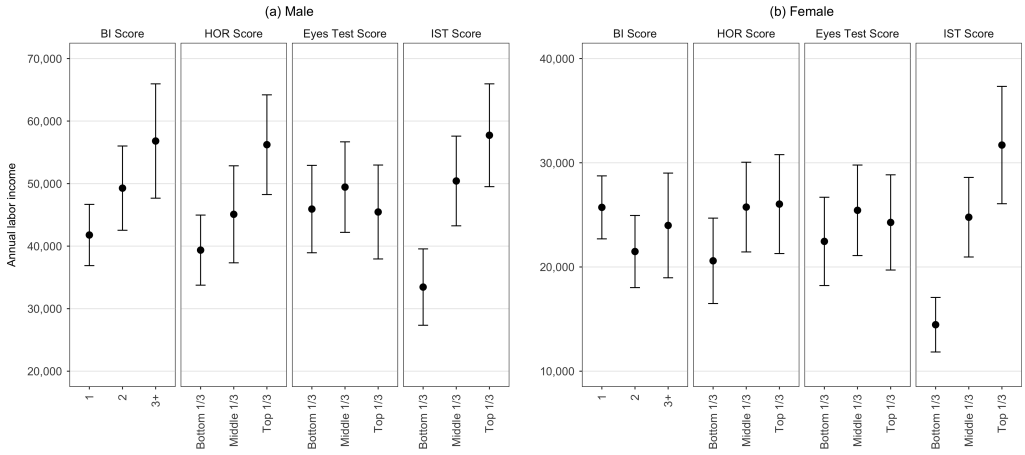


Figure A6. : Annual labor income by strategic thinking skills

Note: Dots represent the average annual labor income of the SLP sample respondents. Caps represent upper and lower bounds of the 95 percent confidence intervals.

Table A11 presents the regression results that estimate the relationship between strategic thinking skills and annual labor income conditional on positive income.

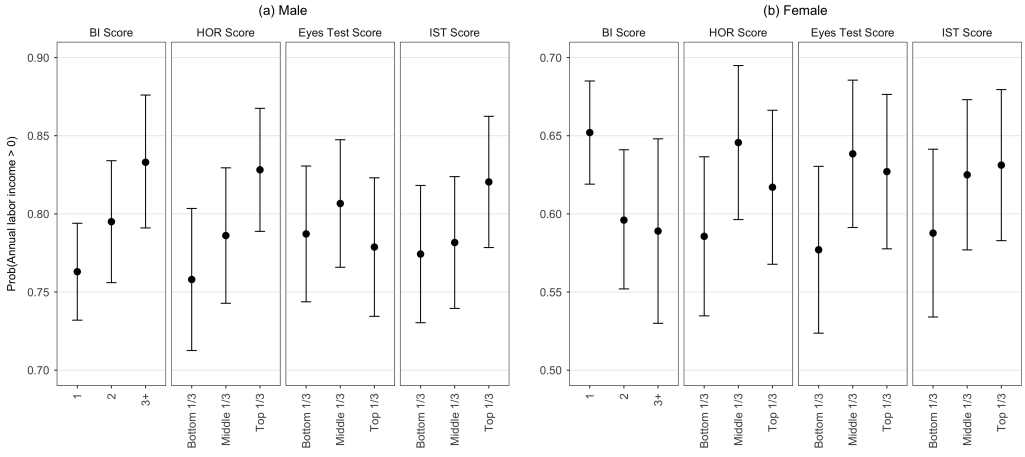


Figure A7. : Extensive margin labor supply by strategic thinking skills

Note: Dots represent the average probability of positive annual labor income for the SLP sample respondents. Caps represent upper and lower bounds of the 95 percent confidence intervals.

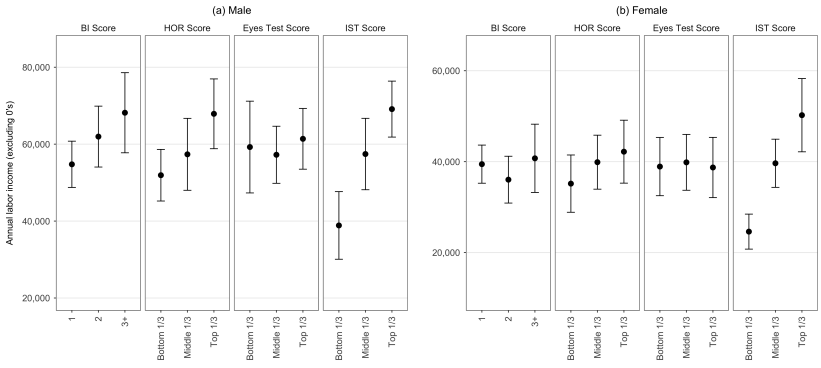


Figure A8. : Labor income (excluding 0s) by strategic thinking skill measures

Note: Dots represent the average annual labor income of the SLP sample respondents conditional on positive incomes. Caps represent upper and lower bounds of the 95 percent confidence intervals.

Table A11—: Regression of annual labor income (excl. 0s)

	(1)	(2)	(3)	(4)
	Male		Female	
BI score	0.057		-0.075	
	(0.046)		(0.057)	
HOR score (standardized)		0.094		-0.065
		(0.077)		(0.103)
Observations	826	826	679	679
R-squared	0.169	0.172	0.172	0.166

Note: Standard errors corrected for heteroskedasticity are reported in parentheses. The dependent variable is a respondent's own annual labor income transformed with the IHS function excluding 0s. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, and the dummy variable reflecting a missing observation for spouse's age for single individuals, education attainment, IST score, and Eyes Test score, financial planning, risk tolerance, self-efficacy, and personal optimism, and time taken to complete each task. Odd-numbered and even-numbered columns include dummy variables for the random orders of the Lift Game and the Line Game, respectively. ***, **, * denote $p<0.01$, $p<0.05$, $p<0.1$, respectively.

A10. Comparing Explanatory Power

Figure A9 shows how R^2 changes for the regression of individual annual labor income when we use different sets of regressors.

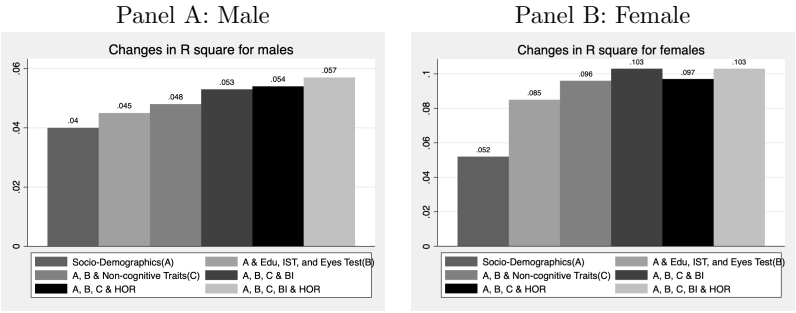


Figure A9. : Changes in R^2 by the choice of regressors

A11. Model

We propose a model of household labor supply to account for the key empirical findings found in this paper, built upon the literature on collective labor supply with household production and workplace production (e.g., Apps and Rees, 1997; Chiappori, 1997). Our main innovation is to introduce two additional features to standard models in the literature as follows. First, we add individual heterogeneity in productivity over two tasks of production to consider the possibility of intrahousehold task specialization according to comparative advantage. Second, we assume positive home-to-workplace spillover and introduce strategic thinking skills as the means of facilitating better coordination for home-to-workplace spillover.

A household consists of two individuals, $i = 1, 2$, who achieve a Pareto-efficient resource allocation. We define three goods as follows: a composite market consumption good, x, with the price set to be 1; a nonmarketable domestically produced good or simply a domestic good, y; a marketable good g, the source of the labor income with the market wage w.[2]

We assume that individuals are heterogenous with respect to their productivity in producing domestic goods and marketable goods and to the way they generate the home-to-workplace spillover. Precisely, each individual i is characterized by three skill parameters: $s_i \in (0, 1)$ refers to the strategic thinking skill; $\alpha_i > 0$

[2]The domestic good essentially captures an aggregation of numerous household-produced commodities such as "the quality of meals, the quality and quantity of children, prestige, recreation, companionship, love, and health status" (pp. 816, **?**).

refers to the productivity parameter for the domestic good production; and $\beta_i > 0$ refers to the productivity parameter for the marketable good production. Let t_i denote time spent in domestic production and l_i denote market labor supply.[3] The household domestic production function is

$$y_i(t_i) = \alpha_i t_i. \tag{A1}$$

The domestic good increases the productivity of the marketable good production.[4] It is not difficult to imagine that better quality of meals, of children, prestige, recreation, companionship, love, and health status would create positive home-to-workplace spillover (see, e.g., Barnett, 1994; Barnett and Marshall, 1992*a*,*b*; Kirchmeyer, 1992). More precisely, the marketable good production function is

$$g_i(t_i, t_j; s_i, s_j) = [y_i(t_i) + s(s_i, s_j) y_j(t_j)]\beta_i l_i, \quad \text{for } i \neq j. \tag{A2}$$

The production function (A2) captures two important aspects of intrahousehold production with positive home-to-workplace spillover. The first term of (A2), $y_i(t_i)\beta_i l_i$, reflects the complementary nature of one's own nonmarketable domestic good production in producing the marketable good. The second term, $s y_j(t_j)\beta_i l_i$, reveals that such complementarity still exists between member j's nonmarketable good production in member i's marketable good production, but achieving the complementarity gain requires coordination between the two household members. $s(s_1, s_2) \geq 0$ is a multiplier that is applied proportionately, where $s(\cdot, \cdot)$ is increasing in both components. Thus, it captures that strategic thinking skills facilitate coordination between the household members and create a larger degree of home-to-workplace spillover. It is a natural adoption of the production function introduced in the literature on task allocation in the workplace (e.g., Autor, Levy and Murnane, 2003; Acemoglu and Autor, 2011; Autor and Handel, 2013; Deming, 2017).

Individuals have strictly quasi-concave, increasing, and twice-differentiable utilities $u^i(x_i)$, $i = 1, 2$. For simplicity, we consider the competitive labor market in which identical firms each hire a worker and pay market wages that are equal to output g_i times an exogenous output price normalized to be 1, i.e., $w_i = g_i/l_i$.

[3] To focus on the household decision problem of allocating their time resource to domestic good production and marketable good production, we exclude pure leisure.

[4] It may be more realistic to assume that a domestic good may not only be a source of the positive home-to-workplace spillover but also directly increase utilities of the household members who consume it. We simplify our model by focusing on the role of domestic good production in a positive home-to-workplace spillover and do not pay attention to its role in generating consumption utility. However, incorporating the consumption utility of a domestic good neither 1) affects the qualitative conclusion of the model that intrahousehold task specialization is more likely to take place when the household members have higher strategic thinking skills nor 2) provides any new insight on intrahousehold task specialization and collective labor supply decision.

Then, the problem for the household is

$$\begin{aligned}\max_{t_1,t_2} u^1 \quad \text{subject to} \quad & u^2 \geq u_0^2, \\ & \sum x_i \leq \sum (w_i l_i + m_i), \\ & y_i = \alpha_i t_i, i = 1,2 \\ & g_i = (y_i + s y_j)\beta_i l_i, i \neq j \text{ and } i = 1,2 \\ & l_i + t_i = 1, i = 1,2 \\ & l_i \geq 0, t_i \geq 0, i = 1,2 \\ & w_i = g_i / l_i, i = 1,2.\end{aligned}$$

where m_i refers to the exogenously given nonlabor income.

The individual heterogeneity we introduced, together with the assumption that individuals pursue the Pareto-efficient resource allocation, implies that the above household optimization problem may have a corner solution; i.e., household members want to specialize in the production of goods in which they have a comparative advantage. To visualize this, assume without loss of generality that individual 1 has a comparative advantage in producing the marketable good, i.e., $\beta_1/\beta_2 > \alpha_1/\alpha_2$. The utility benefit of specialization comes from relaxing the budget constraint achieved by higher total household income. Thus, the above optimization problem boils down to maximizing the total household labor income. It is easy to verify that the total household labor income

$$\text{(A3)} \qquad \sum_{i=1,2} g_i = (\alpha_1 t_1 + s\alpha_2 t_2)\beta_1(1-t_1) + (\alpha_2 t_2 + s\alpha_1 t_1)\beta_2(1-t_2)$$

is strictly concave in both t_1 and t_2. Then, the perfect specialization with $(t_1 = 0, t_2 = 1)$ is optimal if and only if $\frac{\partial \sum g_i}{\partial t_1}|_{t_1=0,t_2=1} \leq 0$ and $\frac{\partial \sum g_i}{\partial t_2}|_{t_1=0,t_2=1} \geq 0$ or, equivalently,

$$\text{(A4)} \qquad s \geq \max\left(\frac{\alpha_1}{\alpha_2}, \frac{\beta_2}{\beta_1}\right) := s^*.$$

The following proposition summarizes this finding.[5]

PROPOSITION 1 (Extensive Margin of Labor Supply): *Perfect specialization is optimal for any household with $s > s^*$. In this case, only one member of the household who has a comparative advantage on the marketable good production participates in the labor market.*

[5] $s^* \leq 1$ iff $\frac{\beta_1}{\beta_2} \geq 1 \geq \frac{\alpha_1}{\alpha_2}$, i.e., when no household member has absolute advantage on both marketable good production and domestic good production.

From equation (A3), it is straightforward to show that the household member i's labor income strictly increases in both s_i and s_j, and it is still true even when the perfect specialization takes place. Thus, we have our next proposition as follows.

PROPOSITION 2 (Household-level, Gender-independent Positive Associations): *Conditional on intrahousehold task specialization, the labor income of the household member who has comparative advantage on the marketable good production, or equivalently household labor income, increases not only in his own but also in his spouse's strategic thinking skills.*

It is noteworthy that the predictions presented in Propositions 1 and 2 are derived without making any assumption on the distributions of the primitives. We now introduce an assumption on a joint distribution of the individual productivity parameters to obtain our next result about the gender-specific association between strategic thinking skills and labor supply. Let $C_d := \frac{\alpha_2\beta_1}{\alpha_1\beta_2}$ denote a household d's comparative advantage schedule. If $C_d > 1$, member 1 in the household d has a comparative advantage on the marketable good production. Assume that C_d is distributed over $[0, \infty)$ where its *median*, denoted by $M(C_d)$, is larger than 1. This assumption ensures that the majority of households engaging in task specialization have a member 1 specializing in marketable good production and a member 2 specializing in nonmarketable good production.

While the model is silent on which gender specializes in marketable and nonmarketable goods productions, our data show that the male labor supply is the primary source of labor income in many households. This pattern is consistent with the literature reporting that the gender gap in labor market participation remains globally persistent (Goldin, 1990; International Labour Organisation , ILO). The literature identified various factors including cultural norms as a main contributor to the observed gender gap (e.g., **????**). We would like to emphasize that it is not the main objective of the current paper to examine and/or identify the exact sources of the observed gender gap. Instead, taking the gender gap as given, we are interested in establishing gender-dependent associations between strategic thinking skills and labor market outcomes and argue that these associations are the outcomes of intrahousehold task specialization pursuing efficient allocation.[6]

To link the model with the data, it is natural to interpret each member's role in the model as representing each gender. First, member 1 is more likely to participate in the labor market if s_1 is higher and member 2 is less likely to participate if s_2 is higher. This is because as s_1 increases, the household is more likely to have task specialization in which case member 1 is more likely to specialize in

[6]We do not explicitly model various sources of gender gaps including gender norms found in the literature. However, all qualitative predictions of our model are robust to introducing such sources as gender norms to affect household labor supply decisions because 1) the results presented in Propositions 1 and 2 hold irrespective of the distributions of the primitives and 2) the results in Proposition 3 still hold when one takes the labor supply decisions as given.

marketable good production. Second, a positive association between member 1's own strategic thinking skill and his labor income is predicted. The positive association is stronger when his own or spouse's strategic thinking skill is higher. However, a negative association between member 2's own strategic thinking skill and her labor income is predicted. The negative association is stronger when her own or spouse's strategic thinking skill is higher. These results are summarized in the following proposition whose proof is straightforward and thus omitted.

PROPOSITION 3 (Individual-level, Gender-dependent Associations): *Suppose that* $M(C_d) > 1$. *Then*

(a) Member 1 *is more likely to participate in the labor market if* s_1 *is higher and member 2 is less likely to participate if* s_2 *is higher.*

(b) A positive association between member 1*'s own strategic thinking skill and his labor income is predicted. The positive association becomes stronger as his own strategic thinking skill is higher and his spouse's strategic thinking skill is higher.*

(c) A negative association between member 2*'s own strategic thinking skill and her labor income is predicted. The negative association becomes stronger as her own strategic thinking skill is higher and her spouse's strategic thinking skill is higher.*

Our collective model of labor supply presents the first systematic channel in the literature through which a non-market-participating household member contributes to household labor income. The degree of positive home-to-workplace spillover is the key determinant of the household labor supply decision, which is substantially affected by both household members' strategic thinking skills. Our experimental result provides strong supporting evidence for this channel. First, in line with Proposition 2, both married males' and females' strategic thinking skills are positively associated with their household labor income. Second, consistent with Proposition 3, males' strategic thinking skills are positively associated with their individual labor income and negatively associated with the likelihood of being retired; females' strategic thinking skills are negatively associated with their individual labor income and positively associated with the likelihood of being homemakers. Third, as reported in Table 6, we also found that married, non-market-participating females' strategic thinking skills are positively associated with household labor income. Fourth, as reported in Appendix A.A14, females' strategic thinking skills are positively associated with their spouses' individual labor income. This finding suggests that a higher labor income that a market-participating household member receives is driven not only by his/her own human capital facilitating workplace performance but also by positive home-to-household spillover induced by greater strategic thinking skills of both household members.

A12. Alternative Measures of Strategic Thinking Skills

Table A12—: Regression of household labor income on alternative strategic thinking skills

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Male				Female				Non-working Female			
BI score = 1	-0.195				-0.615*				0.082			
	(0.316)				(0.346)				(0.675)			
BI score = 2+	0.000				0.295				1.927**			
	(0.327)				(0.354)				(0.807)			
BI counting score		0.068				0.138				0.720**		
		(0.129)				(0.137)				(0.318)		
HOR score: mid 1/3			0.161				0.769**				0.890	
			(0.333)				(0.380)				(0.701)	
HOR score: top 1/3			0.779**				0.900**				1.803***	
			(0.307)				(0.364)				(0.689)	
HOR order				0.207***				0.154*				0.410**
				(0.067)				(0.084)				(0.172)
Observations	938	938	938	938	822	822	822	822	338	338	338	338
R-squared	0.048	0.047	0.054	0.055	0.154	0.148	0.152	0.147	0.211	0.203	0.205	0.203

Note: Standard errors corrected for heteroskedasticity are reported in parentheses. The dependent variable is a respondent's own annual labor income transformed with the IHS function. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, the dummy variable reflecting a missing observation for spouse's age for single individuals, education attainment, IST score, Eyes Test score, financial planning, risk tolerance, self-efficacy, personal optimism, and time taken to complete each task. Columns (1), (2), (5), and (6) include dummy variables for the random order of the Lift Game. Columns (3), (4), (7), and (8) include dummy variables for the random order of the Line Game. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

A13. Pooled Regression of Multiyear Annual Labor Income

Contemporaneous labor income in 2014 (or any given year) could have a measurement error. To address this concern, we utilize multiple observations of a respondent's annual labor income data for 2014–2016 and conduct the pooled regression analysis of annual labor income on strategic thinking skills, including the full set of controls.

The regression results in Tables A13 and A14 reinforce the baseline findings reported in Table 4 for individual labor income and Table 6 for household labor income. The magnitudes and statistical significance generally remain similar.

Table A13—: Pooled regression of individual labor income on strategic thinking skills

	(1)	(2)	(3)	(4)
	Male		Female	
BI score	0.340**		-0.414**	
	(0.136)		(0.163)	
HOR score (standardized)		0.495**		-0.014
		(0.223)		(0.262)
Observations	3,089	3,089	3,278	3,278
R-squared	0.058	0.056	0.096	0.095

Note: Standard errors clustered at the respondent level are reported in parentheses. The dependent variable is a respondent's own annual labor income transformed with the IHS function. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, the dummy variable reflecting a missing observation for spouse's age for single individuals, educational attainment, IST score, the Eyes Test score, financial planning time horizon, subjective risk tolerance, self-efficacy, personal optimism, and time taken to complete each task. Columns (1) and (3) include dummy variables for the random order of the Lift Game. Columns (2) and (4) include dummy variables for the random order of the Line Game. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

We also check the robustness of the regression results for the extensive and intensive margin analyses of individual labor income using multiyear observations. The results shown in Table A15 remain robust.

Table A14—: Pooled regression of household labor income on married respondents' strategic thinking skills

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Male		Female		Non-working Female	
BI score	0.157		0.029		0.615**	
	(0.102)		(0.118)		(0.256)	
HOR score (standardized)		0.648***		0.526**		0.876**
		(0.183)		(0.217)		(0.416)
Observations	2,782	2,782	2,461	2,461	1,011	1,011
R-squared	0.051	0.058	0.148	0.148	0.191	0.193

Note: Standard errors clustered at the respondent level are reported in parentheses. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, and the dummy variable reflecting a missing observation for spouse's age for single individuals, education attainment, IST score, Eyes Test score, financial planning time horizon, subjective risk tolerance, self-efficacy, personal optimism, and the time taken to complete each task. Odd-numbered and even-numbered columns include dummy variables for the random orders of the Lift Game and the Line Game, respectively. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

Table A15—: Pooled regression results for multiyear annual labor income

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dep. Var: Annual labor incomes (excl. 0s)				Dep. Var: I (Annual labor income > 0)			
	Male		Female		Male		Female	
BI score	0.055		-0.071		0.027**		-0.037**	
	(0.037)		(0.048)		(0.012)		(0.015)	
HOR score (standardized)		0.057		-0.148*		0.042**		0.006
		(0.062)		(0.079)		(0.020)		(0.024)
Observations	2,414	2,414	2,023	2,023	3,089	3,089	3,278	3,278
R-squared	0.194	0.196	0.173	0.170	0.042	0.042	0.076	0.075

Note: Standard errors clustered at the respondent level are reported in parentheses. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, and the dummy variable reflecting a missing observation for spouse's age for single individuals, education attainment, IST score, Eyes Test score, financial planning, risk tolerance, self-efficacy, and personal optimism, and time taken to complete each task. Odd-numbered and even-numbered columns include dummy variables for the random orders of the Lift Game and the Line Game, respectively. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

A14. Spouse's Labor Income

We first investigate whether there is any linkage between male labor income and their wives' strategic thinking skills. While identifying the exact channels for this relationship goes beyond the scope of this paper, a variety of interpersonal interactions can contribute to this potential linkage, including partner matching, intrahousehold labor supply decisions, and spillover/crossover between home and work (e.g., **?**Rosalind C Barnett and Nancy L Marshall, 1992*a*; **?**). For female participants, we find that a one-level increase in their BI score and a one-SD

increase in their HOR score are robustly associated with respective 39 percent and 75 percent *increases* in their husbands' labor income.

Wife's strategic thinking skills. — We next evaluate the relationship between male labor income and the wife's strategic thinking skills. This relationship can be shaped through a variety of channels, including marriage matching and spillover/crossover between home and workplace (e.g., **?**Rosalind C Barnett and Nancy L Marshall, 1992*a*; **?**). We cannot disentangle those underlying channels due to the lack of data. However, we aim to establish robust associations between an individual's strategic thinking skills and the spouse's labor outcome.

Table A16 reports the regression results of the IHS-transformed annual labor income of female respondents' husbands on female respondents' strategic thinking skill measures. The sample size decreased to 822 after excluding 208 female respondents who were not married at the time of our study due to never marrying, divorce, or bereavement.

In columns (1)–(2), our measures of the strategic thinking skills of female respondents are all positively correlated with their husbands' annual labor income. We find that a one-level increase in a female respondent's BI score is associated with a 49.9 percent higher annual labor income for her husband. Similarly, a one-SD increase in a female respondent's HOR score is associated with a 90.5 percent increase in her husband's annual labor income. The coefficient estimates are statistically significant at the 1 percent level.

The positive correlation between each of a female respondent's strategic thinking skills and her husband's labor income is robust to the inclusion of additional controls for educational attainment, IST score, Eyes Test score, and noncognitive and preference traits. In columns (5) and (6) with the full set of controls, the point estimates indicate that a one-level increase in a female respondent's BI score is related to a 36.2 percent higher annual labor income for her husband, and a one-SD increase in her HOR score is associated with a 70.6 percent increase in her husband's annual labor income. Both estimates are statistically significant at the 1 percent level.

Husband's strategic thinking skills. — Table A17 reports the regression results for IHS-transformed female labor income on their husbands' strategic thinking skills. In this analysis, we excluded 106 male respondents who were not married. Columns (1)–(2) show that the coefficient estimates on the BI score and the HOR score are not statistically significant and remain so after controlling for additional characteristics in columns (3)–(6).

Spouse's labor supply. Table A18 reports the regression results of spouse's labor supply status on respondents' strategic thinking skills by gender. The dependent variable takes the value of 1 if the spouse's annual labor income is positive and 0 otherwise.

Table A16—: Regression of male labor income based on their wife's strategic thinking skills

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var: IHS transformation of annual labor income					
BI score	0.499***		0.380**		0.362**	
	(0.173)		(0.176)		(0.180)	
HOR score (standardized)		0.905***		0.685**		0.706**
		(0.303)		(0.307)		(0.311)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Education and cognitive ability	No	No	Yes	Yes	Yes	Yes
Noncognitive and preference traits	No	No	No	No	Yes	Yes
Observations	822	822	822	822	822	822
R-squared	0.116	0.118	0.127	0.128	0.145	0.143

Note: Standard errors are corrected for heteroskedasticity. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively. Columns (1)–(2) include only demographic variables: age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, and the dummy variable reflecting a missing observation for spouse's age for single individuals. Columns (3)–(4) additionally control for educational attainment, IST score, Eyes Test score. Columns (5)–(6) additionally control for noncognitive traits such as financial planning, risk tolerance, self-efficacy, personal optimism, and time taken to complete a corresponding task. Odd-numbered and even-numbered columns include dummy variables for the random orders of the Lift Game and the Line Game, respectively.

Table A17—: Regression of female labor income based on their husband's strategic thinking skills

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var: IHS transformation of annual labor income					
BI score	-0.019		-0.123		-0.122	
	(0.186)		(0.193)		(0.196)	
HOR score (standardized)		0.460		0.300		0.231
		(0.300)		(0.312)		(0.314)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Education and cognitive ability	No	No	Yes	Yes	Yes	Yes
Noncognitive and preference traits	No	No	No	No	Yes	Yes
Observations	938	938	938	938	938	938
R-squared	0.021	0.023	0.028	0.029	0.039	0.045

Note: Standard errors are corrected for heteroskedasticity. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively. Columns (1)–(2) include only demographic variables: age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, and the dummy variable reflecting a missing observation for spouse's age for single individuals. Columns (3)–(4) additionally control for educational attainment, IST score, Eyes Test score. Columns (5)–(6) additionally control for noncognitive traits such as financial planning, risk tolerance, self-efficacy, personal optimism, and time taken to complete a corresponding task. Odd-numbered and even-numbered columns include dummy variables for the random orders of the Lift Game and the Line Game, respectively.

Table A18—: Regression results for the spouse's labor supply by gender

Variables	(1)	(2)	(3)	(4)
	Dep. Var: I (Annual spouse labor income > 0)			
	Male		Female	
BI score	-0.013		0.031*	
	(0.018)		(0.016)	
HOR score (standardized)		0.012		0.062**
		(0.029)		(0.028)
Observations	938	938	822	822
R-squared	0.041	0.045	0.112	0.109

Note: Standard errors corrected for heteroskedasticity are reported in parentheses. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, the dummy variable reflecting a missing observation for spouse's age for single individuals, education attainment, IST score, Eyes Test score, financial planning, risk tolerance, self-efficacy, personal optimism, and time taken to complete each task. Odd-numbered and even-numbered columns include dummy variables for the random orders of the Lift Game and the Line Game, respectively. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

For male respondents, the measures of strategic thinking skills reported in columns (1) and (2) are not significantly associated with a wife's extensive margin labor supply decision. In contrast, for female respondents, columns (3)–(4) report that female respondents with higher values for the BI and HOR scores are associated with higher probabilities of having a husband who earns a positive annual labor income. The results reported in this subsection are consistent with the findings in Tables A16 and A17.

A15. Potential Channels

Table A19—: Regression results for the occupation choice and social skill requirement

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Manager, professional, service or sales				Score of social skill requirements			
	Male		Female		Male		Female	
BI score	-0.017		-0.030		-0.029		-0.029	
	(0.024)		(0.026)		(0.020)		(0.024)	
HOR score (standardized)		-0.006		-0.044		0.037		-0.014
		(0.038)		(0.046)		(0.033)		(0.039)
Observations	616	616	553	553	630	630	583	583
R-squared	0.153	0.145	0.192	0.194	0.153	0.154	0.052	0.058

Note: Standard errors clustered at the respondent level are reported in parentheses. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, and the dummy variable reflecting a missing observation for spouse's age for single individuals, education attainment, IST score, Eyes Test score, financial planning, risk tolerance, self-efficacy, and personal optimism, and time taken to complete each task. Odd-numbered and even-numbered columns include dummy variables for the random orders of the Lift Game and the Line Game, respectively. ***, **, * denote $p<0.01$, $p<0.05$, $p<0.1$, respectively.

For male respondents, the measures of strategic thinking skills reported in columns (1) and (2) are not significantly associated with a wife's extensive margin labor supply decision. In contrast, for female respondents, columns (3)–(4) report that female respondents with higher values for the BI and HOR scores are associated with higher probabilities of having a husband who earns a positive annual labor income. The results reported in this subsection are consistent with the findings in Tables A16 and A17.

Table A20—: Regression results for household income on the couple's strategic thinking skills

Variables	(1)	(2)
	Dep. Var: IHS transformation of annual household labor income	
Wife's BI score	0.033	
	(0.128)	
Wife's HOR score (standardized)		0.173
		(0.215)
Observations	138	138
R-squared	0.301	0.337

Note: Standard errors corrected for heteroskedasticity are reported in parentheses. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, the dummy variable reflecting a missing observation for spouse's age for single individuals, education attainment, IST score, Eyes Test score, financial planning, risk tolerance, self-efficacy, personal optimism, and time taken to complete each task. Columns (1) and (2) include dummy variables for the random orders of the Lift Game and the Line Game as well as the spouse's BI score and HOR score, respectively. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

A16. Alternative Measures of Strategic Thinking Skills

We examine the robustness of the main results reported in Section III to alternative measures of HOR and BI. In our first alternative measure, we address the nonlinear effects of the HOR score by splitting the sample into equal-sized terciles. The average expected payoffs of the first, second, and third terciles are S$39.0, S$50, and S$67.4, respectively, for male participants and S$192, S$245, and S$333, respectively, for female participants.

Our second alternative measure is the HOR orders, defined based on the dominance solvability of the Line Game.[7] This alternative measure provides a full-rationality benchmark when identifying individuals' HOR. We classify an individual who did not choose S$50 in position A as HOR order 0, an individual who chose S$50 in position A but not S$40 in position B as HOR order 1, etc.[8] Table A21 illustrates the classification criterion we used for the HOR orders. The last two rows of Table A21 present the empirical distributions of the HOR orders. Approximately two-thirds of the respondents are HOR order 0 or 1 in both the SLP and KLIPS samples.

Regarding the BI measure, we first consider the categorical variables of BI reasoning by assigning respondents into 3 group dummies–those with a BI score

[7] A respondent who is one-order rational must choose S$50 in position A. A respondent who is two-order rational must choose S$40 in position B. A respondent who is three-order rational must choose S$30 in position C. A respondent who is four-order rational must choose S$20 in position D. A respondent who is five-order rational must choose S$10 in position E.

[8] This identification method only captures the upper bound of an individual's higher-order rationality because, for instance, it is possible that a person who is able to perform only one round of iterative elimination of strictly dominated strategies randomly chose S$30 in position C. This identification strategy is standard in the literature (e.g., **?**). Kneeland (2015) presented an experimental design that resolves the identification problem of the upper bound approach.

Table A21—: HOR order classifications and empirical distributions

	Order 0	Order 1	Order 2	Order 3	Order 4	Order 5
A	$\neq 50$	50	50	50	50	50
B	-	$\neq 40$	40	40	40	40
C	-	-	$\neq 30$	30	30	30
D	-	-	-	$\neq 20$	20	20
E	-	-	-	-	$\neq 10$	10
SLP	22.1%	44.1%	9.9%	5.6%	2.6%	15.8%
KLIPS	31.2%	46.2%	10.7%	5.5%	1.8%	4.7%

of 1, those with a BI score of 2, and those with a BI score of 3 or higher. These BI categories allow us to detect the nonlinear effects of the BI scores on an individual's labor income. As a second alternative BI measure, we consider the number of rounds each individual won in the Lift Game, referred to as the BI counting score. The empirical distributions of the BI counting score in the SLP and KLIPS samples are reported in Table A22.

Table A22—: Distribution of the BI counting scores

Data	0	1	2	3	4
SLP	32.2%	40.6%	22.4%	2.9%	1.9%
KLIPS	30.2%	43.5%	19.7%	2.7%	3.9%

Table A23 reports the regression results for respondents' annual labor income using the alternative definitions discussed above and with the full set of control variables. Column (1) indicates that male respondents, whose BI score is 2, earn 31.9 percent more than males whose BI score is 1 (not statistically significant), and males whose BI level is 3 or higher earn 89.4 percent more than those whose BI level is 1 (statistically significant at the 5 percent level). Column (5) suggests that female respondents whose BI score is 2 (resp., 3 or higher) earn 90.6 percent (resp., 114.9 percent) less than those whose BI score is 1. These coefficient estimates are statistically significant at the 5 percent level. These nonlinear effects are overall consistent with the findings reported in Table 4, in which linear relations are imposed. This finding is also consistent with the results using the BI counting scores reported in columns (2) and (6) of Table A23. The BI counting score is associated positively with the male respondents' labor income but negatively with the female respondents' labor income at the 5 percent significance level.

Columns (3) and (7) of Table A23 report the regression results using the HOR score terciles. For male respondents, we find that those with HOR scores above

Table A23—: Regression of labor income on alternative strategic thinking skills

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Male				Female			
BI score = 1	0.319				-0.906***			
	(0.357)				(0.347)			
BI score = 2+	0.894**				-1.149***			
	(0.371)				(0.421)			
BI counting score		0.344**				-0.466**		
		(0.156)				(0.185)		
HOR score: mid 1/3			0.184				0.562	
			(0.363)				(0.376)	
HOR score: top 1/3			0.728**				-0.027	
			(0.356)				(0.389)	
HOR order				0.152*				-0.103
				(0.087)				(0.095)
Observations	1,044	1,044	1,044	1,044	1,102	1,102	1,102	1,102
R-squared	0.054	0.053	0.052	0.050	0.105	0.102	0.102	0.101

Note: Standard errors corrected for heteroskedasticity are reported in parentheses. The dependent variable is a respondent's own annual labor income transformed with the IHS function. All columns include age group dummies, the ethnic Chinese dummy, marital status, number of children, spouse's age, the dummy variable reflecting a missing observation for spouse's age for single individuals, educational attainment, IST score, Eyes Test score, financial planning, risk tolerance, self-efficacy, personal optimism, and time taken to complete each task. Columns (1), (2), (5), and (6) include dummy variables for the random order of the Lift Game. Columns (3), (4), (7), and (8) include dummy variables for the random order of the Line Game. ***, **, * denote p<0.01, p<0.05, p<0.1, respectively.

the top one-third of the distribution have, on average, a 72.8 percent higher labor income than those with HOR scores at the bottom one-third. The coefficient estimate is statistically significant at the 5 percent level. For female respondents, we do not find statistically significant relations between the HOR score terciles and their labor income. Column (4) shows that the association between male respondents' labor income and their HOR order is substantial in magnitude: a one-order increase in the HOR order measure is associated with a 15.2 percent increase in male participants' annual labor income. It is, however, statistically significant only at the 10 percent level. We do not find a significant association between the HOR orders and female respondents' labor income in column (8). In sum, these findings are qualitatively consistent with the baseline findings reported in Table 4.[9]

A17. Discussion of External Validity

One might be concerned that our findings are confined to the context of Singapore due to the large cultural and economic differences between Singapore and the rest of the world. To assess this concern, we examine whether the gender

[9]The corresponding results using the annual household income variable are reported in Table A12. The results remain robust.

norms of Singapore are significantly different from those of Western and other Asian countries. We use Wave 6 data from the World Values Survey (and the corresponding wave of the European Values Survey) that was surveyed in 2010–2014 and compare the proportion of respondents who agree or strongly agree with the following two statements among seven countries (Australia, Germany, Japan, Singapore, South Korea, Sweden, and the U.S.): i) having a job is the best way for a woman to be an independent person, and ii) being a housewife is just as fulfilling as working for pay. To be comparable with the age range of the SLP sample, we restrict the age of the World and European Values survey samples to be 50–65 years old. The UK and France are not included because these questions were not asked during the same survey period in these countries.

Figure A10 indicates that Singaporeans do not exhibit skewed perceptions about gender roles compared with people in other Asian countries or Western countries. The proportion of participants who agree or strongly agree with the first statement is 0.67 for Singapore, which is fairly high and comparable to those for other countries. Regarding the second statement, the response of Singaporeans is also similar to those from the U.S., Australia, Japan, and South Korea, while Germany and Sweden record slightly higher figures.

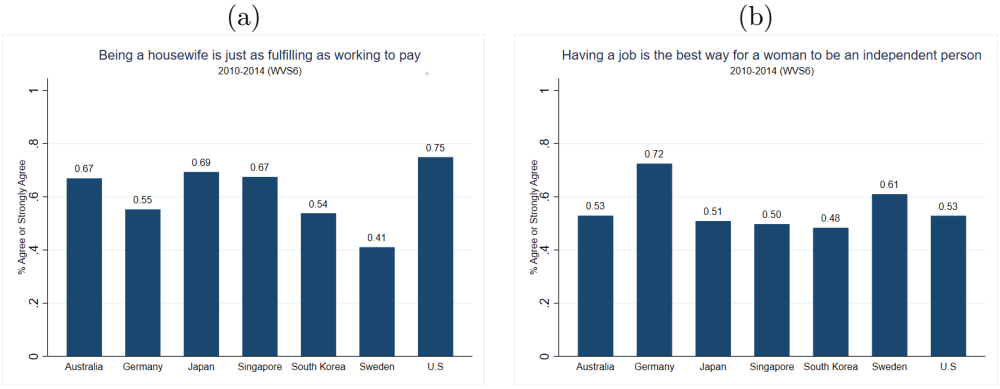


Figure A10. : Gender norms

Source: Authors' calculation based on data from the World Values Survey and the European Value Survey.

We also compare the female labor market participation rate and GDP per capita across countries between 2000 and 2020, which are presented in Figure A11. During this period, Singapore's GDP per capita and female labor market participation rate were as high as those of most of the comparison countries. This descriptive evidence suggests that the gender norms and female labor market activities in Singapore are not particularly different from those of other developed countries. Thus, we argue that the findings of this study can be applicable to other countries.

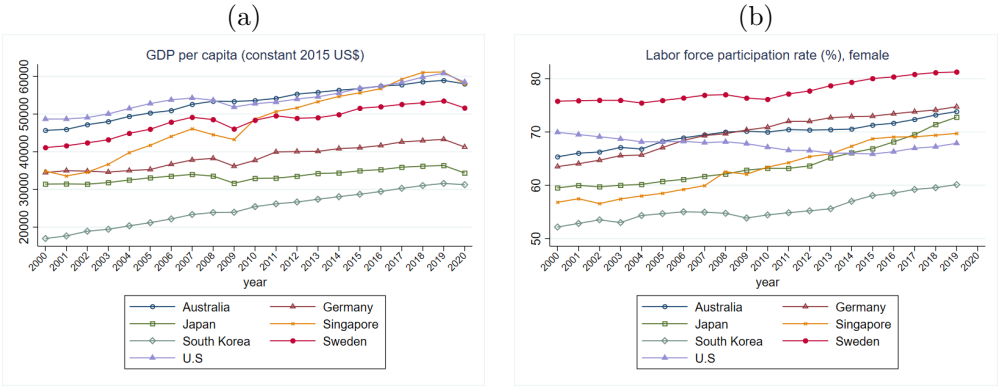


Figure A11. : Per capita GDP and female labor market participation

Source: World Bank (2022)

In addition, as we use a sample of individuals aged 50–65, we only examine the associations between strategic thinking skills and labor market outcomes in the later part of the life cycle. As such, there could be a concern about whether these associations remain robust in the earlier part of the life cycle. Although we cannot directly address this concern using the SLP data, we find that the distributions of our HOR and BI measures and their correlations with other cognitive and non-cognitive traits are consistent between SLP and KLIPS (Tables 1, 2, A4. Since the KLIPS consists of a nationally representative sample of Korean individuals aged 15 and above, the similarity between SLP and KLIPS suggests that the use of older study participants is unlikely to change the interpretation of our main results. Nonetheless, it would be fruitful to explore the relationship between strategic thinking skills and marriage matching/occupational choice using a sample of younger individuals.