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Homo Economicus vs. Human Being : Outcomes of Irrationality

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Homo Economicus vs. Human Being : Outcomes of Irrationality*

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Abstract

This paper investigates the individual outcomes of irrational thinking, including paranormality and non-scientific thinking. These modes of thinking are identified by factor analysis from a 2008 survey. Income and happiness are used as measures of performance. Empirical results reveal that non-scientific thinking lowers income, whereas paranormality does not affect it. While non-scientific thinking lowers happiness, paranormality raises it. Extending the model, we find that higher ability and self-control result in higher income and happiness. Selfishness raises income, but diminishes happiness. These results suggest that *Homo economicus* generally achieves higher individual performance, except that belief in paranormality raises happiness.

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Keywords; paranormality, non-scientific thinking, irrationality, happiness, factor analysis, Homo economicus

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1. Introduction

This paper aims to discover how irrationality affects the performance (income and happiness) of human beings.

Rationality is the essential assumption of traditional economics, meaning that agents act in a self-interested fashion given their constraints. In addition to rationality the following elements are commonly ascribed to "*Homo economicus*": unlimited cognitive resources, pure self-interest, and perfect self-control. However, this is not the only possible description of economic agents; *Homo economicus* is often simply adopted for modeling convenience. Therefore, it is interesting to ask: "Does *Homo economicus* exhibit performance that is superior to real-world human beings?" In this paper, we focus on the effect of irrationality on performance, although we also investigate the impact of the other characteristics of *Homo economicus*.[1]

The consequences of irrationality have been studied in the field of behavioral finance. DeLong et al. (1990) analyzed the efficiency of a financial market that consists of a mix of rational and irrational agents, and showed that this market can be inefficient if irrational agents comprise a substantial fraction of the market participants.[2] The result

[1] Konow and Earley (2008), based on their dictator game experiment, found that more generous people report greater happiness.

[2] The authors assume that rational agents are risk averse, which restricts them from making an unlimited arbitrage.

suggests that whether or not irrationality leads to lower profitability depends on the total number of irrational agents in the market. If irrational agents dominate, behaving irrationally in concordance with many other irrational agents can be profitable.

Shumway and Wu (2006) empirically analyzed the Shanghai stock exchange and found that traders who show the disposition effect earn less profit. Barber and Odean (2001) showed that men transact too often because of their overconfidence, leading to low profitability. These empirical results are consistent with the hypothesis that irrationality reduces profitability.

We consider the core of rationality to consist of logical thinking, which is the unique tool by which human beings identify the appropriate actions to achieve their goals. We measure individuals' degree of logical thinking by assessing the degree to which they believe in science and the degree to which they believe in paranormal phenomena. Although these may seem to be two sides of the same coin, they actually have different characteristics, as will be demonstrated in section 2.[3] While paranormality has not often been analyzed in the economics literature, there have been many studies on this topic in the field of psychology. However, the relationship between paranormal beliefs and individual success has, to our knowledge, not yet been studied.

[3] Lindeman and Aarnio (2007) offer some support for this; they report that superstition is well predicted by ontological confusion, but not by analytical thinking.

The majority of Japanese people do not believe in any religion: according to our large scale-survey, 56% answered "None" to the question "Please indicate if you are affiliated with any of the following religions." Also, 58.5% answered "It doesn't hold true at all" to the statement "I am deeply religious;" those who answered "It is particularly true" comprised only 3.4%. Nonetheless, belief in paranormal phenomena is popular, especially for the younger generation, as in many countries (Williams 2007, Rice 2003, Peltzer 2003). Thus, belief in paranormal phenomena in Japan, especially among younger individuals, may not stem from religious beliefs, but from superstitions spread by mass media.[4]

We assess an individual's performance with two measures: 1) income, and 2) happiness. Success in the world is often evaluated by income, assets, and social status; attainment of these goals is largely determined by physical laws, although chance also plays a large role. On the other hand, human beings also pursue subjective happiness, which is strongly affected by one's mental condition. Indeed, Wills (2009) reported that higher satisfaction with spirituality and religiosity brings about significantly higher well-being (see also Cohen 2002). Although happiness depends on income to some degree, the two may sometimes diverge. Thus, we investigate how paranormality and

[4] Fortunetelling based on blood types or horoscopes is broadcasted daily on many Japanese TV channels.

non-scientific thinking affect both income and happiness.

The remainder of this paper is organized as follows. In section 2, we explain the data and methods used. In section 3, we present the basic results and check robustness. In section 4, we extend the basic model to examine how characteristics of *Homo economicus* other than rational thinking affect performance. Section 5 concludes.

2. Data and methods

In this section, we explain our dataset and report the results of a preliminary analysis regarding the origins of belief in paranormality and non-scientific thinking.

2.1 The questionnaire survey

All data used in this paper were obtained from a survey conducted by the COE (Center of Excellence) project of Osaka University in February 2008. Three thousand and forty eight (3,048) people aged 20-75 were selected from all over Japan by double stratified random sampling. Selected respondents were visited at their homes and handed the questionnaire. Several days later, completed questionnaires were picked up. Two thousand seven hundred and thirty one (2,731) questionnaires were returned (response rate of 89.6%). At the same time, 3000 individuals were randomly chosen from all over

Japan, and the same questionnaire was sent by postal mail to these. One thousand two hundred and eighty seven (1,287) of these were returned (response rate of 42.9%). In this paper, these two samples are pooled and used for the analysis, so that the total number of observation is 4,018.

2.2 Questions associated with irrationality

We designed questions that elicit an individual's degree of belief in paranormality (henceforth "paranormality") and non-scientific thinking; we collectively refer to these two measures as "irrationality." Paranormality is assessed with eight questions and non-scientific thinking with three; these questions are listed in Table 1. Each response is on a five-point scale.

The standard questions used to measure paranormality, the Paranormal Belief Scale (PBS), were developed by Tobacyk and Milford (1983) and are widely used (Hergovich and Arendasy 2005, Aarnio and Lindeman 2005, Dagnall et al. 2007, Peltzer 2003). These authors propose a 25-item questionnaire based on the results from factor analysis of a 61-item pool. Factor analysis revealed seven independent dimensions comprising belief in the paranormal. Out of our eight questions on paranormality, four are related to factor 1 in Tobacyk and Milford, one belongs to factor

2, and one to factor 7. Thus, our questions are somewhat similar to those in Tobacyk and Milford. However, Wiseman and Watt (2004) criticize the PBS, pointing out "this scale refers solely to negative superstitions (e.g., breaking a mirror will cause bad luck) and omits items referring to positive superstitions (e.g., carrying a lucky charm will bring good luck)." Another measure, the Belief in Paranormal Scale (BIP), has been proposed, which assesses both paranormal beliefs and experiences (Thalbourne and Delin 1993, Rattert and Bursik 2001). Williams et al. (2006) and Rice (2003) each propose their own measures. In sum, although the PBS is the most common measure used to assess paranormal beliefs, there exist a variety of alternatives.

From Table 1, we can see that belief in paranormality and non-scientific thinking are predominant. Except for the question regarding "Human beings evolved from other living things," the modal response is in the middle of the 5-point scale. Though the number of responses indicating non-belief in science is a minority, the distribution of the answer is almost symmetric for the questions on the existence of gods, heaven, ghosts, and the afterlife. Many answered "true" for questions such as "God or gods exist" "Life after death exists," and "God knows about all the wrong things we've done."

2.3 Factor analysis

We asked eleven questions concerning irrationality. Needless to say, irrationality is not the sole determinant of the answers to these questions. Therefore we performed a factor analysis on the set of eleven questions.[5]

The results of that factor analysis are presented in Table 2. It is clear that the first factor has a large loading on the eight questions associated with paranormalilty, while the second factor strongly relates to the three questions associated with non-scientific thinking. We therefore name the first factor *PARANORMAL* and the second *NONSCIENTIFIC*.

2.4 Where do belief in paranormality and non-scientific thinking come from?

In this subsection we examine how paranormality and non-scientific thinking emerge. We particularly focus on the effect of the respondents' childhood environments.

We define the average years of schooling of a respondent's parents as *EDUCTION_P*.[6] We hypothesize that higher parental education directly and indirectly leads to children thinking more rationally. Another variable is standard of living at age 15 (*LIVING_15*), which ranges from 0 (poorest) to 10 (wealthiest). Although the direction of the effect on rationality is not intuitively obvious, we hypothesize that

[5] Specifically, we use principal factor analysis (PFA) with promax rotation.
[6] When respondents have only one parent, the variable is defined as the schooling years of that parent.

growing up with hardship will discipline children and keep them from subscribing to irrationality, other thing being equal. Another important variable is intelligence, which, we hypothesize, increases rationality. We proxy for intelligence with a respondent's self-reported grades (averaged across all academic subjects) at the age of 15 (*ABILITY*).[7]

Gender may play an important role, because boys and girls are often educated to behave differently and to seek different life goals. We include a dummy variable *DMAN*, which takes on a value of unity for males and zero for females. Age may represent generation, which could reflect the degree to which the media reported on paranormal phenomena when that generation was young; alternatively, belief in paranormality might depend on age itself. Thus, we add age decade dummies (e.g. *D_AGE20* is a dummy representing whether a respondent is in his or her 20s) to the regression. The dummy for 70s is deleted as the benchmark.

Estimation results by ordinary least squares (OLS) are presented in Table 3. Factors influencing paranormality appear on the left. Females tend to have stronger belief in paranormality than males, which is consistent with previous studies (Rice 2003,

[7] Musch and Ehrenberg (2002) used grades in junior high school as a proxy for cognitive ability and examined the correlation with paranormality.

Wolfradt 1997, Wiseman and Watt 2004, Williams et al. 2007).[8] Paranormality tends to be strongest when respondents are in their 40s. Those who had higher grades at age 15 tend to exhibit less paranormality, as do those whose parents are more educated. Interestingly, a higher childhood standard of living is associated with more paranormality.

Results regarding non-scientific thinking are shown in the right-hand columns. The results are similar to those for paranormality. The only differences are that childhood standard of living is not significant, and that non-scientific thinking decreases monotonically with age. This last result presents an interesting contrast with the result for paranormality. Respondents in their 40s were teenagers around 1978, when paranormal phenomena (spoon-bending by Uri Geller and Kokkuri-san, a kind of table-turning, etc.) were very popular in the media. Therefore, we might be seeing a generational effect.

2.5 Income and happiness as measures of life performance

We use two measures of an agent's life performance: income and happiness. The former is a purely economic measure of performance, while the latter is psychological and

[8] However, Peltzer (2003) finds no significant gender differences among secondary and university students in South Africa.

self-evaluative. 2007 pretax income (on a 12-point scale) is included as a question in the survey. Following Barsky et al. (1997), we fit a lognormal distribution to the income histogram and estimate the income for each class; this estimation result is called *INCOME*.

HAPPINESS is defined by the answer to the following question: Overall, how happy would you say you are currently? Using a scale from 0 - 10 where “10” is “very happy” and “0” is “very unhappy”, how would you rate you current level of happiness?

2.6 Statistical analysis

We regress the performance variables, *INCOME* and *HAPPINESS*, on the variables representing irrationality, *PARANORMAL* and *NONSCIENTIFIC*, and on other control variables. Because males tend to earn higher incomes than females, we include the dummy variable *DMAN*. In Japan, wage rates are often tied to age; therefore, we add the variables of age (*AGE*) and its square (*AGE_SQ*).[9]

Thus, the regression equation for *INCOME* is:

$$INCOME_i = a_0 + a_1 PARANORMAL_i + a_2 NONSCIENTIFIC_i + a_3 DMAN_i +$$

[9] We also estimated a specification using age dummies instead of age and its square. However, the results are almost identical.

$a_4 AGE_i + a_5 AGE\_SQ_i + \varepsilon_i$ (1),

where *i* indexes individuals and ε_i is a disturbance term. Equation (1) is estimated by OLS. However, the inclusion of the male dummy variable may cause a problem. Since females tend to be more paranormal, the dummy may be collinear with *PARANORMAL*. Therefore we also estimate a variant of equation (1) on male-only and female-only subsamples.

Since it is well known that happiness depends on gender and age (Frey and Stutzer 2002), we add these variables to the regression equation for *HAPPINESS*:

$$Happiness_i = b_0 + b_1 PARANORMAL_i + b_2 NONSCIENTIFIC_i + b_3 DMAN_i + b_4 AGE_i + b_5 AGE\_SQ_i + \varepsilon_i \quad (2)$$

It is also known that subjective happiness depends on income in cross sectional analyses (Frey and Stutzer 2002). Thus, we estimate a variant of equation (2) that includes income:

$$Happiness_i = b_0 + b_1 PARANORMAL_i + b_2 NONSCIENTIFIC_i + b_3 DMAN_i + b_4 AGE_i + b_5 AGE\_SQ_i + b_6 INCOME_i + \varepsilon_i \quad (3)$$

We must be careful regarding the interpretation of the estimation results for equation (3): b_1 and b_2 represent the direct effects of irrationality, but even if b_1 and b_2 are found to be statistically insignificant, these variables may indirectly affect

HAPPINESS through *INCOME*. Equations (2) and (3) are estimated by ordered probit, since *HAPPINESS* is an ordered variable. In addition, in order to compare the magnitude of direct and indirect effects, we conduct a path estimation.

3. Estimation results

3.1 Effect of irrationality on income

The estimation results for equation (1) are presented in Table 4. On the left are shown the results when income is regressed over only the key variables, *PARANORMAL* and *NONSCIENTIFIC*. Both coefficients are significantly negative, implying that paranormal and non-scientific thinking lowers economic performance.

In the right columns, estimates for equation (1) are presented. The coefficient on non-scientific thinking is negative and significant. The maleness dummy, *DMAN*, is significantly positive, as expected. Age and squared age are also significant, and are positive and negative respectively, implying that income peaks at age 48. The coefficient on *PARANORMAL* is insignificant.

In order to check if belief in paranormality affects income independent of gender, we estimate equation (1) for single-gender subsamples. The results for males are similar to the total sample; whereas *NONSCIENTIFIC* is significantly negative,

PARANORMAL is negative but insignificant (p-value = 0.266, results not shown). On the other hand, for the female-only subsample, most of the coefficients are not significant, suggesting that the specification is not adequate to explain female income. It is not easy to explain how female earnings are determined: for example, marital status and income of husband (if married) may strongly affect how much a woman earns. The result that *PARANORMAL* is not significant for either gender suggests that income may not depend on belief in paranormality.

In sum, controlling for gender, we have a robust result that non-scientific thinking lowers income, while there is no clear evidence that belief in paranormality has any effect on income.

3.2 Effect of irrationality on happiness

Estimation results for equation (2) (the *HAPPINESS* regression) are presented in panel A of Table 5. The left-hand columns show the results when only the two key explanatory variables are included. Interestingly enough, the coefficient on *PARANORMAL* is positive here, indicating that those who believe in paranormal phenomena are happier, while the coefficient on *NONSCIENTIFIC* is significantly negative, implying that non-scientific thinking lowers happiness. This result highlights

the substantial functional difference between belief in paranormality and non-scientific thinking.

In the right columns, results for the full specification of equation (2) are shown. Once again, the coefficients of the two key variables, *PARANORMAL* and *NONSCIENTIFIC*, are significantly positive and negative, respectively. Age and squared age are not significant at all.

In panel B of Table 5, we present the results of equation (3), where *INCOME* is added to equation (2). While the coefficient on *INCOME* is highly significant as expected, the coefficients on *PANRANORMAL* and *NONSCIENTIFIC* are almost unchanged from panel A. The coefficient on *DMAN* becomes larger and age and squared age become significant, indicating that the happiness function is U-shaped in age, consistent with many previous studies (Clark 2007).[10] We should note that the coefficients of *PARANORMAL* and *NONSCIENTIFIC* in panel B represent their direct effect on happiness; they have also an indirect effect through income.

In order to compare the magnitude of direct and indirect effects, we conducted a path estimation. The results are shown in Figure 1. Here, we assume that paranormality and non-scientific thinking are affected by gender and age, that income is affected by all

[10] The results using age dummies indicate that happiness is lowest during people's 50s.

four of these variables, and that happiness depends on these four and income. The figure reveals that income is influenced by non-scientific thinking, but not by paranormality, and that happiness is influenced by both (with opposite signs). This confirms the results shown in Tables 4 and 5. Looking at standardized coefficients, the indirect influence of non-scientific thinking on happiness through income appears to be much smaller than the direct influence.

3.3 Robustness check: Alternative measures for *PANRANORMAL* and *NONSCIENTIFIC*

In this subsection, we check the robustness of the results presented in the previous subsections. In particular, we check if the results remain unchanged when alternative measures for paranormality and non-scientific thinking are used.

Previous studies have examined the relationship between religious and paranormal beliefs (Williams et al. 2006, Rice 2003, Smith and Simmonds 2006). Education is also believed to relate to paranormal beliefs (Aarnio and Lindeman 2005, Peltzer 2003). Thus, it may be reasonable to include attitudes towards religion (*RELIGION*) and education level (*EDUCATION*) in our set of raw outcome variables, from which paranormality and non-scientific thinking are extracted by factor analysis. Specifically,

RELIGION is defined as a survey respondent's agreement with the statement "I am deeply religious," and *EDUCATION* is defined by years of schooling.

We conducted a factor analysis of 13 outcome variables, including *RELIGION* and *EDUCATION* (results not shown). The factor loading of *RELIGION* on factor 1 is 0.216, implying that it contributes to factor 1 as expected, but weakly. On the other hand, *EDUCATION* has a factor loading of -0.132 on factor 2, which is a small contribution. The other variables show similar factor loadings on both factors 1 and 2. Based on these results, we construct new variables *PARANORMAL2* and *NONSCIENTIFIC2*.

We estimate equations (1) through (3) with *PARANORMAL2* and *NONSCIENTIFIC2* on the left-hand side. All of the results in Tables 4 and 5 are qualitatively confirmed (results not shown); *NONSCIENTIFIC2* becomes more significant, and its coefficients become larger, than in the previous estimations. Thus, the conclusions in the previous subsections are robust to the inclusion of religion and education in the factor analysis by which we define paranormality and nonscientific thinking.

4. Performance of the *Homo economicus*: An extension

Homo economicus is characterized by rationality, perfect intellectual ability, perfect selfishness, and perfect self-control. Although we have focused on the effects of rationality, it is interesting to ask how the other attributes of *Homo economicus* affect individual performance. In this section, we define proxies for the other aforementioned characteristics of *Homo economicus*, using other answers to our survey questions, and we investigate the effects of each characteristic on our performance measures.

4.1 Definitions of variables

In this subsection, we define the additional variables used in the regression analysis.

Intellectual ability (*ABILITY*)

For intellectual ability, we use subjects' self-reported school grades at age 15. Respondents were asked to choose from a 5-point scale, from 1 ("in the lower rank") to 5 ("in the higher rank").

Selfishness (*SELFISH*)

To measure selfishness, we used the answer to the following survey question: Does the following statement hold true for you? "I don't sit in a priority seat on public transportation because I want to offer it to others." Again, the response is on a 5-point scale, from 1 ("This is particularly true for me") to 5 ("This is not true for me at

all"). *SELFISH* is defined by this answer.

Self-control (*SELFCONTROL*)

For the self-control variable, we asked whether the following six statements held true for the respondents, on a 5-point scale from 1 (not hold true at all) to 5 (particularly true).

a) Even if I make plans, I end up procrastinating.
b) I always keep my promises.
c) When I have something I want, I can't bear not to buy it.
d) I always plan carefully before making an action.
e) No matter how angry I get, I don't shout at others.
f) When I am faced with a problem, I usually act before I think.

SELFCONTROL is defined by the sum of these answers; where appropriate, the signs of answers are reversed so as to assign higher values to greater self-control.[11]

Our regression equations are just equations (1) through (3), adding *ABILITY*, *SEFLISH*, and *SELFCONTROL* as regressors. Higher values of these variables means that subjects are more akin to *Homo economicus*.

4.2 Estimation results for the extended model

Estimation results for the extended model are presented in Table 6. In the left-hand columns, the results for the extended equation (1) are shown. Paranormality and

[11] We also defined two other variables, *SC_PLAN*, which is defined by the sum of answers to the questions a) through d), and *SC_FEEL*, which is defined by the sum of e) and f). However, estimation results using these are not different from those using *SELFCONTROL*.

non-scientific thinking are negative but insignificant, though this may be due to collinearity. Gender and age give almost the same impact on income as in the original equation (1). *ABILITY* and *SELFCONTROL* are positive and significant, while *SELFISH* is not significant; this indicates that those who are generally akin to *Homo economicus* tend to achieve higher incomes.

In the middle of the table, results for the extended equation (2) are shown. Paranormality affect happiness positively, and non-scientific thinking negatively, as in Table 5. Thus, the impacts of these variables on happiness are robust. The results for gender and age also do not change much. The effects of the other newly-added explanatory variables are almost the same as in the income regression. The only difference is that *SELFISH* is now negative and insignificant rather than positive and insignificant. The negative sign of the point estimate is consistent with previous studies on altruism (Konow and Earley 2008, Phelps 2001). When income is added (extended equation (3)), the estimation results are almost unchanged (right-hand columns).

5. Conclusions

This paper investigated the individual-level outcomes of irrationality. Although rationality usually brings about higher outcome, if irrationality predominates in society,

this may not be the case (DeLong et al. 1990). Thus, it is interesting to examine the outcome of irrationality empirically. We used two main concepts of irrationality, paranormal beliefs and non-scientific thinking, which were abstracted from eleven questions by factor analysis. Although both of these represent irrationality in that they contradict facts, factor analysis revealed that they are distinct phenomena.

This paper adopts two measures of individual performance: income and happiness. Although intuition suggests that income is a good measure of economic performance, this does not hold true for females in Japan. On the other hand, happiness is a good measure of self-evaluated performance, including psychological aspects.

Empirical results reveal that non-scientific thinking lowers income, while paranormality does not. Interestingly enough, non-scientific thinking and paranormality affect happiness in opposite directions: the former lowers happiness while the latter raises it. As belief in religion is known to raise happiness (Cohen 2002), belief in paranormality might act similarly to religiosity.

We extended our analysis to investigate the effects of various other characteristics of *Homo economicus*. Higher ability and self-control resulted in higher income and happiness. Selfishness did not have a significant impact. These results, in general, support the idea that *Homo economicus* achieves higher performance than other

subspecies of humanity.

The present paper has many limitations. First, income does not work well as a measure of economic performance for women in Japan. Since we obtained similar results for the male-only and total samples, the results for income seem credible. Still, finding a good measure for economic performance for females is a goal for the future.

Second, endogeneity of the regressors may be a problem. The regressors are basic traits of human beings, which are probably inherited or determined in childhood, so that they should essentially be exogenous to the income and happiness of adults. However, we cannot totally deny the possibility that these basic traits are influenced by standard of living in adulthood. Since it seems formidable task to find appropriate instrumental variables from the questions of our survey, addressing the possible endogeneity problem remains as a future work.

Third, *Homo economicus* may have basic traits that the present paper overlooked. For example, hyperbolic discounting produces time inconsistency and less efficient behavior (Laibson 1997), whereas *Homo economicus* may be characterized by exponential discounting. In addition, human beings in the real world cannot be homogenous: for example, naïve and sophisticated persons have systematically different behavior (O'Donoghue and Rabin 1999). Thus, analysis of various types of human

beings is called for. Given these arguments, the present paper only takes a small step toward the study of *Homo economicus* as a benchmark for human effectiveness.

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Table 1. Questions on irrationality and descriptive statistics of the answers

Category	Question	Name of variables	Share (%)					mean	Standard deviation
			1	2	3	4	5		
paranormality	Spirits and Ghosts exist.	*GHOST*	15.21	15.33	40.58	20.60	8.27	2.914	1.136
	Heaven exists.	*HEAVEN*	10.40	11.10	48.86	22.08	7.55	3.053	1.023
	God or Gods exist.	*GOD*	9.58	10.55	40.41	28.53	10.93	3.207	1.081
	Life after death exists.	*AFTERWORLD*	14.71	12.96	43.18	20.62	8.53	2.953	1.124
	God knows about all the wrong things we've done.	*WRONGDOING*	10.71	12.72	39.70	26.31	10.56	3.133	1.106
	It is possible to move an object by using psychokinesis.	*PSYCHOKINESIS*	27.90	25.57	38.03	7.04	1.45	2.286	0.995
	I believe in fortune telling.	*FORTUNETELLING*	16.39	19.74	44.48	17.52	1.87	2.687	1.003
	A person's blood type indicates their character.	*BLOODTYPE*	12.74	20.03	42.72	23.33	1.17	2.802	0.975
non-scientific thinking	Human beings evolved from other living things.	*EVOLUTION*	18.33	36.64	34.96	6.22	3.84	2.406	0.981
	You should place a greater value on thinking with your head than with your heart.	*HEADTHANHEART*	5.12	33.52	56.01	4.72	0.62	2.622	0.685
	What is written in science text books is true.	*SCIENCETEXT*	5.41	38.65	49.66	5.13	1.15	2.580	0.724

Note: Each question asks: "Do you agree with the following idea?" Larger numbers indicate greater paranormality and more non-scientific thinking.

Table 2. Rotated factor loadings and uniqueness

Variable	Factor1	Factor2	Uniqueness
AFTERWORLD	0.856	0.015	0.265
GOD	0.809	−0.054	0.349
HEAVEN	0.802	−0.038	0.360
GHOST	0.704	0.041	0.498
WRONGDOING	0.702	−0.090	0.509
FORTUNETELLING	0.644	0.058	0.577
PSYCHOKINESIS	0.530	0.149	0.685
BLOODTYPE	0.427	0.020	0.816
HEADTHANHEART	−0.001	0.502	0.748
EVOLUTION	−0.066	0.362	0.868
SCIENCETEXT	−0.087	0.338	0.883

Note: Principal factor analysis with promax rotation was applied.

Table 3. Causes of paranormality and non-scientific thinking

	PARANORMAL		*NONSCIENTIFIC*	
	Coef.	p value	Coef.	p value
Constant	0.214	[0.047]**	0.204	[0.006]***
DMAN	-0.436	[0.000]***	-0.112	[0.000]***
D_AGE20	0.401	[0.000]***	0.380	[0.000]***
D_AGE30	0.440	[0.000]***	0.255	[0.000]***
D_AGE40	0.521	[0.000]***	0.256	[0.000]***
D_AGE50	0.306	[0.000]***	0.208	[0.000]***
D_AGE60	0.075	[0.257]	0.143	[0.002]***
EDUCATION_P	-0.024	[0.005]***	-0.011	[0.063]*
LIVING_15	0.051	[0.000]***	0.004	[0.489]
ABILITY	-0.087	[0.000]***	-0.080	[0.000]***
Adjusted R^2	0.116		0.044	
Number of Observations	3588		3588	

Table 4. Estimation results for equation (1)

	Coef.	p value	Coef.	p value
Constant	312.783	[0.000]***	-560.175	[0.000]***
PARANORMAL	-40.511	[0.000]***	-6.878	[0.192]
NONSCIENTIFIC	-38.322	[0.000]***	-21.744	[0.004]***
DMAN			327.185	[0.000]***
AGE			31.794	[0.000]***
AGE_SQ			-0.328	[0.000]***
Adjusted R^2		0.022		0.299
Number of observations		3235		3235

Note: Dependent Variable is income. Estimation method is ordinary least squares.
AGE_SQ is squared age.

Table 5. Estimation results for happiness equations

Panel A. Results for equation (2)

	Coef.	p value	Coef.	p value
PARANORMAL	0.073	[0.000]***	0.044	[0.014]**
NONSCIENTIFIC	-0.146	[0.000]***	-0.161	[0.000]***
DMAN			-0.185	[0.000]***
AGE			-0.0004	[0.969]
AGE_SQ			-0.00002	[0.836]
Pseudo R^2		0.003		0.005
Number of observations		3895		3895

Panel B. Results for equation (3)

	Coef.	p value	Coef.	p value
PARANORMAL	0.076	[0.000]***	0.042	[0.038]**
NONSCIENTIFIC	-0.152	[0.000]***	-0.168	[0.000]***
INCOME	0.0003	[0.000]***	0.001	[0.000]***
DMAN			-0.368	[0.000]***
AGE			-0.022	[0.038]**
AGE_SQ			0.0002	[0.064]*
Pseudo R^2		0.005		0.011
Number of observations		3211		3211

Note: Dependent variable is *HAPPINESS*. Estimation method is ordered probit.

Table 6. Estimation results for the extended model

	INCOME		*HAPPINESS*			
	Coef.	p value	Coef.	p value	Coef.	p value
Constant	-819.365	[0.000]***				
PARANORMAL	-1.357	[0.797]	0.060	[0.001]***	0.056	[0.007]***
NONSCIENTIFIC	-8.593	[0.268]	-0.083	[0.002]***	-0.099	[0.001]***
DMAN	330.319	[0.000]***	-0.177	[0.000]***	-0.327	[0.000]***
AGE	32.895	[0.000]***	-0.001	[0.957]	-0.018	[0.096]*
AGE__SQ	-0.343	[0.000]***	0.000	[0.655]	0.000	[0.211]
SELFISH	5.733	[0.202]	-0.017	[0.293]	-0.025	[0.156]
ABILITY	44.935	[0.000]***	0.179	[0.000]***	0.142	[0.000]***
SELFCONTROL	4.115	[0.014]**	0.043	[0.000]***	0.040	[0.000]***
INCOME					0.001	[0.000]***
R^2		0.324		0.018		0.020
Number of observations		3144		3752		3122

Note: We show Adjusted R-squared for the income regression, and pseudo R-squared for the happiness regression.

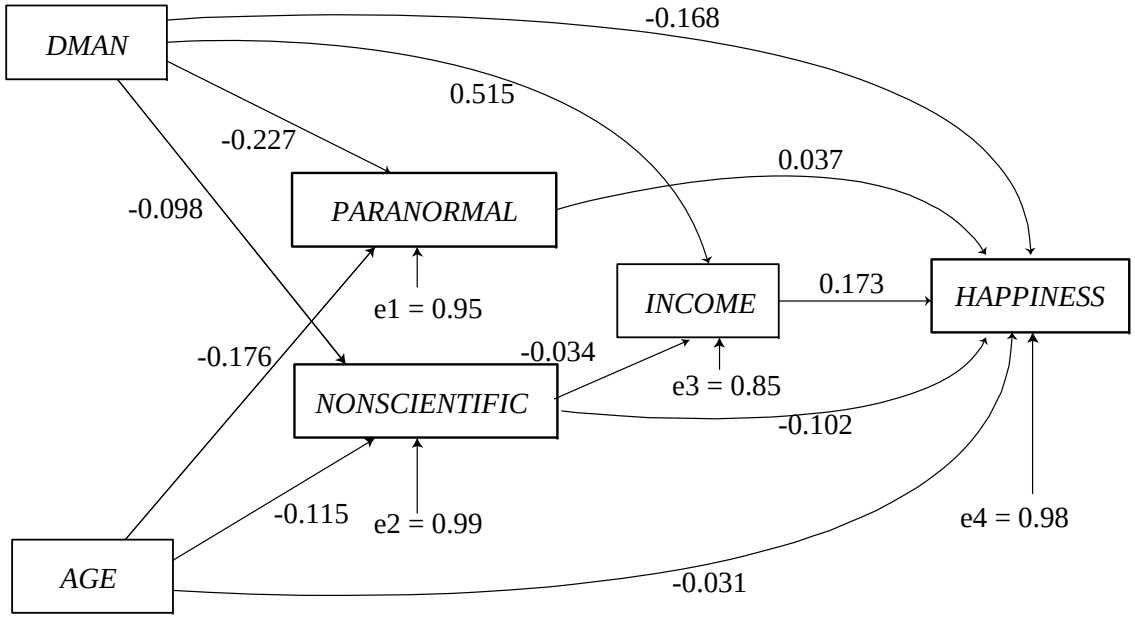

Figure 1. Path diagram

Note: Values in the figure are standardized coefficients. e1 to e4 are random terms.