



Reference-dependent preferences and probability judgments

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ABSTRACT

This paper provides empirical evidence that probability judgments help explain a reference-dependent preference. It explains using the data for Tokyo Taxi drivers, which includes the respondents about psychological questions. Probability judgments based on a dual process to cognition means judgments and calculations of the probability when they determine something under uncertainty. It weakens the assumption that people have the same rationality. We permit the difference between cognition to rationality and probability judgments. These probability judgments relate to reference points and drivers' personalities and intuition, which influence decision-making and can explain several reference dependences. The difference of cognition to rationality also determines their reference dependence type. It uses Rational Experienced Inventory as the index of cognition to rationality. Frequentist type has different target variables with case type, subjective type, and fortune type. Each probability judgment type has each target as the reference point. Probability judgment types explain the type of cognition to rationality. This explains the endogeneity of reference dependence.

1. Introduction

The theory of reference-dependent preferences has its roots in the concept of loss aversion (Kahneman & Tversky, 1979; Koszegi & Rabin, 2006). Amos Tversky and Kahneman (1991) present an analysis of choice in a riskless framework.

The results of several psychological studies indicate differences in people's perceptions of rationality (Epstein, 1994; Pacini & Epstein, 1999, etc.). People will calculate past frequencies and past probabilities of occurrence in order to predict future events. As a result, they can create their reference points. However, previous studies about reference dependence have not adequately considered probability judgments based on these probability and frequency calculations (Crawford & Meng, 2011; Farber, 2008; Rabin, 2017; Haggag et al., 2017; Sakai and Hisano, 2017; Markle et al., 2018; Tereya et al., 2017; Bhatia & Golman, 2018).

Gigerenzer and Hoffrage (1995) showed that people make a reasonable inference based on frequency view if natural sampling is acquired. Some people can accurately calculate the likelihood using Bayesian inference, the mathematical law of probability. They must calculate and judge the probability when they determine something under uncertainty. The results of that probability calculation will differ depending on the type of method used to calculate the probability, i.e., frequency or Bayesian inference. Their types call probability judgment type (Norman, 1983; Baker, 2019; Costello & Watts, 2016a, 2016b; Crupi & Tentori, 2016). They may make different reference points by individual probability judgment type. This paper suggests that people's reference points are related to their probability judgments and personality. This study examines two. Firstly, it examines whether an individual's reference point varies by personality or probability judgment. Secondary, it examines whether differences in rationality affect reference dependence. Hawkins and Kapadia (1984) proposed four types that classify probability judgments into conceptual and mental models based on

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Norman (1983). They suggested an a priori type, a frequency type, a subjective type, and a formal type.

This paper has been divided into four types: Case (formal and a priori), Frequency, Subjective, and Fortune, subject to Hawkins and Kapadia (1984) and Adachi (2004). We make one type using their formal type and a priori type. We use Fortune type from Adachi (2004). Our study illustrates that people use reference points as a target. People are rational but differ in their attitudes and abilities to pursue rationality.

Furthermore, as part of the process of pursuing rationality, they also differ in the way they predict the probability of occurrence of an event, i.e., the way they make probability judgments. Crawford and Meng (2011) show that people have two reference points. This paper provides that they have different reference points by probability judgment types. They assumed that people may have only one reference point, no reference point, or two reference points. North (2010) describes that two learning experiences reduce uncertainty—the learning experience in the physical environment and the learning experience in the social and cultural environment. Whether people take a point in time or through time, experience varies with each culture and each physical environment.

People interpret differently under certain events. For example, they have different probability judgments. Therefore, they have different uncertainties. So knowing how learning occurs in their mind is essential to understanding how people deal with uncertainty. North (2010) states that uncertainty can be reduced by: 1) The uncertainty that can be reduced by increasing information given the existing knowledge stock. 2) The uncertainty can be reduced by increasing knowledge stock given the existing institutional framework. 3) The uncertainty that can be reduced by changing the institutional framework. 4) Uncertainty can be reduced by rebuilding beliefs when faced with a new situation. 5) The Uncertainty that provides the basis for “irrational” beliefs.

This study shows that the reference point is endogenously determined. While economics research assumes rational individuals, psychological research assumes that people do not have the same degree of rationality. In order to integrate these two fields of study, this study clarifies the relationship between different degrees of rationality and reference points. This study will show that people also have different ways of predicting probability under uncertainty. Furthermore, it will clarify the relationship between the type of probability judgment, which is a method of predicting probability, and the reference point.

2. Previous reviews

2.1. Reference dependent

Kahneman and Tversky (1979) suggested that people have more sensitivity to utility in the loss range than in the gain range. In such a situation, people have a non-linear utility function. They proposed a probability weighting function that transforms probability values into weights for decisions. Rabin (2017) suggested three types of the decision-making environment; (1) Under certainty, (2) under risk, and (3) under uncertainty. Firstly, the consequences of people’s decisions under certainty are always unchanged while determining a choice. There are not that many of these situations. The consequences that people choose under certainty are predictive and constant. Secondly, The probability of occurrence that people will decide under risk is known even if uncertain events occur. If the likelihood of happening of event A is X percent and the gain is P dollars, then the benefit is Q dollars if the probability of event B is (1 - X) percent. We can calculate $P \times X + (1-X) \times Q$ using the concept of expected gain. (3) can be divided into two. They are (3–1) ambiguity and (3–2) ignorance. (3–1) means that the probability is unknown. So, they cannot calculate the expected income based on rational expectations. (3–2) means that the probability is unknown, and people also do not recognize sample space.

Slovic (2000) suggested that decision-making under risk is related to the person’s trust to risk. Rabin (2017) suggested three candidates for the reference point. Firstly, it is Status Quo. The original assumption in prospect theory was that the reference point is the status quo or endowment. Second, it concerns social preferences. People create their standards by comparing their results with those of others around them. Thirdly, it concerns Goals or Aspirations. Are the kind and number of an individual’s reference dependence related to the individual’s cognitive judgment of probability?

2.2. Probability judgment

Norman (1983) divided probability judgment into two models; the concept model and the mental model. Hawkins and Kapadia (1984) divide probability judgment into four types. Firstly, classical probability is defined as the probability based on the hypothesis that an event is equally likely to occur. Probability which is pips of one is one into six patterns, which have equal probability when a man shakes a die. The expectation is one-sixth. Secondly, the frequent probability is defined as a probability based on frequency from each result by repeated trial. The probability which gets pips of one by the infinite test is one-sixth. Third, subjective probability is defined as a probability based on the degrees of individual belief. Its probability is high if they believe they can get easy pips of one. Fourthly, axiomatic theory (measure theory) is a probability subjected to the law of mathematical probability theory.

Gigerenzer and Hoffrage (1995) argued that the probabilities they predict and use in daily life are not necessarily related to the knowledge they learned in school for many people.

They argued that many people recognize the probability aside from mathematical understanding.

The case type tended to overlook the condition of probability prediction based on the condition of equal certainty. Furthermore, they found that it may not be possible to adequately predict multiple events, such as the simultaneous occurrence of each equally specific event. People based on frequency type do not fully understand that they are not subject to a law of large numbers. Konold (1989) advocated the result approach. He considered anticipating the result of one trial based on the target to judge under an uncertain situation. He considered that people calculate probability when people think about happened probability and the change under an unpredictable event.

Adachi (2004) divided the probability judgment into seven types. (1) Case type based on the classical definition of Hawkins and Kapadia (1984). A priori probability - the probability obtained by assuming an equal likelihood in the same space. This may also be called 'theoretical' probability. (2) Frequentist probability type. The probability is calculated from observed relative frequencies of different outcomes in repeated trials. Some authors have termed it an 'empirical' probability. (3) Subjective case type, which is incorrectly perceived case type of (1). As per the Subjective and Intuitive probabilities of Hawkins and Kapadia (1984), to a greater or lesser extent, the probability is an expression of personal belief or perception. (4) Subjective frequentist type is incorrectly perceived as a frequentist type of (2). (5) The anchorage adjustment type adjusts the probability with less objectivity or objective quantification and subjective probability as the initial value, using credible information, profit and loss arithmetic, controllable occurrence probability, and concern. (6) Fortune approach, in which occurrence probability is influenced by uncontrollable hope. Like a frequentist, a fortune type also does not care about probabilities and does not change his behavior even if the likelihood is known. The fortune type believes that uncertainty is caused by probabilities and fate. (7) Formal probability - the likelihood is calculated precisely using the mathematical laws of probability, Bayesian. It is sometimes known as objective probability or normative probability. (Table 1).

This paper divides seven types of Adachi (2004) into four types according to Hawkins and Kapadia (1984). Its four types are the fortune type (6), case definition (1)(7), frequentist type(2), and subjective definition (3)-(5) in Adachi (2004). It adds fortune type to the four types of Hawkins and Kapadia (1984). Furthermore, we make a priori and formal types as case types. The types of classification in this study, Frequentist probability and Subjective probability are consistent with the classification of Hawkins and Kapadia (1984). In this study, Classical and Formal were integrated into Case. The reason for integration is that very few people make calculations based on Bayesian estimation. Both Classical and Formal are consistent in that they objectively recognize probabilities based on calculations, which is different from the other types. This paper suggests how to decide on reference dependence. They have new targets when they predict uncertain situations. Anchorage type may always predict daily income from early daily situations based on their experience.

Judgment based on experience implies changing the reference point based on new information. It implies Bayesian inference. It may update prediction probabilities using daily information updates based on experience, and the change of prediction probability makes new goals again. New goals may make a new reference point.

They may not determine labor supply using their target because the case type predicts the probability mathematically. The subjective type (anchorage adjustment type) makes a reference point using new daily information.

Subject means incorrect operations of the case and frequentist type of Hawkins and Kapadia (1984) and anchorage type. Frequentist types predict the normal mean as a probability under uncertain circumstances and therefore have the potential to use reference dependence to make decisions. Fortune type may also not care about the probability, such as frequentist. They would not change their behaviors even if they knew the likelihood. They recognize that certain phenomena do not occur based on probability theory but rather by chance. They may not calculate or predict the probability of success. They may do not predict the likelihood of achieving the goals. Target and reality distance may not affect decision-making. Daily labor supply applies the rational expectation theory. As mentioned above, not everyone can accurately determine probabilities. This may affect the formation of reference points.

2.3. Reference dependent and probability judgment

There are no previous reviews on the relationship between reference dependence and probability judgments.

2.4. Labor supply of cab drivers under reference-dependent preferences

Farber (2008), Crawford and Meng (2011) suggested that self-employed workers determine the reference points based on their

Table 1
Probability Judgment Type.

Hawkins and Kapadia (1984)	This study	Adachi (2004)	Judgment type characteristic
Frequency	Frequency	Frequency	Frequentist probability types, the probability is calculated from observed relative frequencies of different outcomes in repeated trials. Some authors know this as 'empirical' probability.
Classical	Case	Case	The case type is based on the classical definition of Hawkins and Kapadia (1984). Classical probability - the probability obtained by assuming equal likelihood in the same space. This may also be called 'theoretical' probability.
Formal		Formal	The likelihood is calculated precisely using the mathematical laws of probability Bayesian. This is sometimes known as 'objective' or 'normative' probability.
Subject	Subjective	Anchorage	Adjusts the probability with less objectivity or objective quantification and subjective probability as the initial value, using credible information, profit-and-loss arithmetic, controllable occurrence probability, and concern.
		Case	Be incorrectly perceived case type. Subjective and Intuitive probabilities of Hawkins and Kapadia (1984), to a greater or lesser extent, the probability is an expression of personal belief or perception. Such a possibility may be embryonic precursors to category(4). Writers differ in whether or not they see these probabilities as distinct and, if so, in their ideas about the nature of any such distinction.
-	Fortune	Frequency Fortune	Be incorrectly perceived above frequentist type. Occurrence probability is influenced by uncontrollable hope.

rational expectations, such as income target or hours target as reasons why they quit daily labor supply.

Daily labor supply for owner drivers is different at each probability judgment type. We confirm using the model of daily labor supply by Crawford and Meng (2011). Farber (2008) showed that the labor supply model, which involves an index function of 1 if real income is higher than the income target, is effective in a reference-dependent model. Farber (2008) estimated the income target. The income target is positively significant, but its variance is large and unstable. Crawford and Meng (2011) investigated that owner-driver makes daily target hour or daily target income as a reference point. They showed that owner-drivers make decision-making based on rational expectations. As a reference point, this paper introduces rational expectations by using the mean of daily income or daily hours of the day of the week for each driver. It divides the data at the point where expected income is more than earned income for the first hour since the driver started working in the day. Then, it estimates the probit model using stopping work after the driver gets off the customer as the dependent variable.

As a result, in the Case of lower income, the driver determines the daily hour when real income reaches the target income. In this range, income relates negatively to labor hours. In the Case of higher income, the driver finishes daily work when actual hour reaches the target hour. So, they showed that owner-drivers finished daily work when they searched for two targets; income and labor hours.

There are some researches that the experiences and something types determine reference dependence.

The primary hypotheses in this study are the following.

1) Probability judgments help explain the reference-dependent preference.

This study investigates the relationship between reference dependence and probabilistic judgment. Hence, we verify that owner-taxi drivers' goals are reference points and that the distance between the real and the goal determines their behavior. Furthermore, we investigate the type of probabilistic judgment for each owner-taxi.

1a) The type of probability judgment explains the type and number of reference points.

The goals and aspirations may also differ depending upon individual personality, i.e., the degree of rationality and the way probabilities are predicted under uncertainty. This study assumes that the reference dependence type differs at each probability judgment type. This study considers that differences in perceptions of rationality are also related to the type of referential dependence. The number of probability judgment types is four. A probability judgment type may have one reference point. Another type may have two. A difference between cognition and rationale is related to following the rational expectation theory. Individual focusing on intuition has no reference point as the target. If they have the highest cognition to rationality type, they may have two reference points.

For 1a) above, we set three additional hypotheses. A) Individuals who use Case and frequentist to determine probability under uncertainty have the same two reference point results as Crawford and Meng (2011). B) An individual who guesses the possibility based on his/her subjective image does not determine the probability of whether real income reaches the daily income target. C) An individual considers luck, not probability, as the reason for an uncertain event. So, they do not make a reference point even if an uncertain event occurs.

2) Differences in rationality make a difference in reference dependence.

Section 3 describes the data used for probability judgments. It confirms the correlation between probability judgments and reference points and shows the relationship between indicators of the degree of rationality and probability judgments.

Section 4 explains our model. Finally, Section 5 describes our original data. We passed this questionnaire to negotiate directly with Tokyo owner taxi drivers in 2017.

Section 6 explains estimation results about probit estimation of each probability judgment. Finally, Tables 3 and 4 summarize the ratio and correlation of self-reported reference points and each probability judgment type.

Tables 5 to 7 provide tabulation and correlation of probability judgment type and Rational Experimental Inventory (REI). REI shows the degree of cognition to rationality. The reliability of REI as a Personality index is shown in Table 6. It confirms whether REI is related to the self-reported reason to quit daily work and not only to the probit estimation results. Section 7 discusses the results.

Table 2
Number of Occurrences Each Type.

	All	case	Frequentist	Subjective			Fortune
				Case	Frequentist	Anchorage	
Watch	55	0 (0)	22 (0.40)	1 (0.02)	4 (0.07)	5 (0.09)	23 (0.42)
Birthday	54	22 (0.41)	0 (0)	3 (0.06)	15 (0.28)	3 (0.06)	11 (0.20)
Soccer	54	0 (0)	1 (0.02)	32 (0.60)	3 (0.06)	11 (0.20)	7 (0.13)
Dice	51	34 (0.67)	0 (0)	4 (0.08)	3 (0.06)	6 (0.12)	4 (0.08)
Left-hand	51	0 (0)	24 (0.47)	9 (0.18)	17 (0.33)	0 (0)	1 (0.02)
Insurance	48	0 (0)	6 (0.13)	0 (0)	3 (0.06)	31 (0.65)	8 (0.17)
Overseas	52	0 (0)	25 (0.48)	3 (0.06)	7 (0.13)	9 (0.17)	8 (0.15)
Sum	365	56	25	52	52	65	62

*Appearance rate in parentheses

*The answers about the probability of occurrence of an event was regarded as an effective respondent. If they did not answer about the probability of occurrence of an event or no answer was considered invalid.

*If more than one type applies per question, include it in all applicable items.

Table 3
type of reference point (self-reported) and probability judgment type.

		reference point			All
		labor hour	income	labor hour and income	
prob. judge.	Case	2	4	11	17
	Freq.	8	9	10	27
	Subjective	2	8	0	10
	Fortune	1	0	4	5
All		13 (0.22)	21 (0.36)	25 (0.4)	59

Pearson chi2 = 45.833 * ** , Parentheses indicate ratios

Table 4
The correlation between the type of reference point (self-reported) And probability judgment type.

		reference point		
		labor hour	income	labor hour and income
prob. judge.	Case	-0.229***	-0.190***	0.401***
	Freq.	0.282***	-0.053***	-0.198***
	Subjective	-0.071***	0.435***	-0.378***
	Fortune	-0.015	-0.228	0.246***

* $p < 0.05$; * $p < 0.1$

*** $p < 0.01$;

Tables 9 to 11 provide the probit estimation results, which include only two reference point variables and two-level variables along with some driver-specific variables, the probability judgment type of the taxi driver as independent variables. Table 12 provides correlation of the probability judgment type and the experiential month of the taxi driver. In this study, probability judgment type is related to an individual's degree of rationality, an indicator of rational and intuitive personalities.

3. Data

3.1. Questions that determine probability judgment

This section describes the original data and questions about probability judgment. Probability judgment is classified, from the answers to seven questions in line with Adachi (2004), into four probability judgment types. A questionnaire contains the participant's attitude and cognition and considers the possibility of seven uncertain events. Each question can answer fourteen choices.

We determined one of four types of probability judgment of Hawkins and Kapadia (1984) from the answer that participants chose through the questionnaire.

This study classifies the sample into four categories according to the four categories of Hawkins and Kapadia (1984). The following are seven questions and answered examples by probability judgment type. Their type is the Case, frequentist, subject, and Fortune. Anchorage in subjective type is a type that forms mooring points and adjusts mooring points. Appendix A provides the survey items for the probability determination of cab drivers.

3.2. Results of probability judgment

In this subsection, we describe the answers which are right mathematically.

Watch problem can be solved using the frequentist definition. "In manufacturing a large number of products, there is a possibility

Table 5
REI Index (Summary statistics).

		Ave.	Std.	Cronbach α
Rationality	Ability	39.3	3.3	0.059
	Attitude	49.17	3.01	0.048
Intuition	Ability	34.91	2.32	0.046
	Attitude	40.54	2.99	0.063
Ambiguity tolerance		72.29	4.74	0.074
Logical-intentionality		49.26	3.16	0.029
Self-esteem		29.51	2.11	0.033
Social desirability		17.55	2.83	0.042

Table 6
Relation among REI index.

		Ambiguity tolerance	Logical-intentionality	Self-esteem	Social desirability
Rationality	Ability	-0.128	0.236*	-0.047	-0.092
	Attitude	0.086	0.207*	0.050	-0.063
Intuition	Ability	0.265**	-0.009	0.281**	-0.049
	Attitude	0.381***	-0.213*	0.216*	0.034

*** p < 0.01;

** p < 0.05;

* p < 0.1

Table 7
Probability judgment type and REI.

		REI			
		Rationality		Intuition	
		Ability	Attitude	Ability	Attitude
prob. Judge.	Case	0.385***	0.287**	-0.092	-0.444***
	Freq.	0.201	0.231*	-0.115	0.364***
	Subjective	-0.617***	-0.641*,*,*	0.228*	-0.133
	Fortune	0.059	-0.093	-0.028	0.300**

*** p < 0.01;

** p < 0.05;

* p < 0.1

Table 8
Summary Statistics.

	Number	Average	Std.	Min	Max
work stop (stop= 1)	4916	0.100	0.300	0	1
Cumulative Total hours	4916	8.114	5.670	5.67	26.2
Cumulative Income	4916	1.173	0.778	0.065	5.3933
Cumulative Total hours>hours target	4916	0.559	0.497	0	1
Cumulative income>income target	4916	0.164	0.370	0	1
trip	4916	6.332	3.945	1	18
fare	4916	18.762	9.821	4.909	89.7
temperature_max	4916	18.056	8.013	3.8	37.1
temperature_min	4916	9.352	8.334	-2.3	26.9
rainfall_sum	4916	2.388	6.403	0	46
wage	4916	1.044	1.880	0.098	50.5
probability judgment_group	4916	2.047	1.01	1	4

that a few percent of defective products may occur.” Birthday problems can be solved using the classical definition. A complimentary event of probability that at least 2 in 40 have the same birthday, 40 means all different birthdays, is about 0.89. $1 - (364/365)^{363} = 0.89$. Dice problems can be solved using classical and frequentist definitions. The probability of the pips of one infinite repeated trial is 1/6. Alternatively, the possibility of pips of dice with the same probability and six patterns is 1/6. If 5% of the Japanese are left-handed, the probability that the Japanese A is left-handed is also 5%. Foreign travel problems and foreign insurance can be solved using frequency definition using past data. The rate in the face of disaster among foreign travelers, which Japan’s ministry of foreign affairs published in 2016, is 0.001.

3.3. Summary statistics for probability judgment

Table 2 displays the number of probability judgment types per question.

The probability judgment type for each respondent is the type that has the most answers and categorizes each of the seven questions like the types. The most common type of probability judgment made in response to multiple questions was the type of probability judgment made by the respondent.

The case type is 56 people. 25 in the Frequentist type. 169 in the Subjective type. 62 in the Fortune. The answers about the probability of occurrence of an event were regarded as an effective respondents. If they did not answer about the probability of occurrence of an event or no answer was considered invalid. If more than one type applies per question, include it in all applicable items.

Table 9
Marginal Effect: Linear Probit with each probability judgment type.

	(1)	(2)	(3)	(4)	(5)
	Pooled data	Case	Frequentist	Subjective	Fortune
Cumulative Total hours>hours target	0.013* (0.020)	-0.024 (0.030)	0.036* (0.017)	-0.009 (0.039)	-0.134 (0.092)
Cumulative income>income target	0.121*** (0.024)	0.082* (0.043)	0.147*** (0.040)	0.052* (0.016)	-0.059 (0.047)
Cumulative Total hours	0.007*** (0.002)	0.006** (0.002)	0.005* (0.003)	0.010*** (0.003)	0.041*** (0.014)
Cumulative Income/100	0.010 (0.014)	0.016 (0.011)	0.002 (0.023)	0.033 (0.025)	0.048 (0.064)
Log-likelihood	-5422.555	-845.546	-2045.323	-1923.542	-377.717
Pseudo R2	0.173	0.359	0.170	0.143	0.265
Observations	19637	4646	7210	6455	1326

The dependent variable is one if the driver stops daily work after customers get off—otherwise, 0.

Robust standard errors in parentheses

* * p < 0.05,

*** p < 0.01,

* p < 0.1

Table 10
Marginal Effect: Linear Probits with each probability judgment type.

	(1)	(2)	(3)	(4)	(5)
	Pooled data	Case	Frequentist	Subjective	Fortune
Cumulative Total hours>hours target	0.026* (0.016)	-0.025 (0.024)	0.018* (0.021)	-0.023 (0.030)	-0.131* (0.074)
Cumulative income>income target	0.028* (0.018)	0.061* (0.035)	0.028 (0.029)	0.007* (0.029)	-0.038 (0.038)
Cumulative Total hours	0.011*** (0.002)	0.005** (0.002)	0.011*** (0.003)	0.010** (0.005)	0.045*** (0.013)
Cumulative Income/100	0.040*** (0.014)	0.019* (0.012)	0.031 (0.021)	0.068** (0.031)	-0.004 (0.056)
Min temperature	Yes	Yes	Yes	Yes	Yes
Max temperature	Yes	Yes	Yes	Yes	Yes
Rainfall	Yes	Yes	Yes	Yes	Yes
Drivers	Yes	Yes	Yes	Yes	Yes
Day of week	Yes	Yes	Yes	Yes	Yes
Log-likelihood	-4779.260	-796.172	-1782.405	-1703.693	-340.841
Pseudo R2	0.271	0.396	0.276	0.241	0.336
Observations	19637	4646	7210	6455	1326

The dependent variable is one if the driver stops daily work after customers get off—otherwise, 0.

Robust standard errors in parentheses

*** p < 0.01,

** p < 0.05,

* p < 0.1

It is seven questions about probability. In watch problem, it means in everyday situations that betray the expectation that they should get it. Misattribution is prone to problems. Soccer and dice problems that we have asked about one trial in the play scene. It is prone to problems of the illusion of control, and gambler's fallacy. It is a problem under a neutral setting that many people are not very interested in. The birthday problem is difficult to judge using the law of product. Foreign travel and foreign insurance are similar.

Nevertheless, the former includes decision making. A follower does not include it. We confirm if probability judgments depend on whether or not it includes decision-making.

3.3.1. Case (A priori and formal) type

In the Dice problem, the case type is 67%. The frequentist type is also correct. However, this type is 0%.

The birthday problem is an appearance rate of 41%, but one made a mathematically incorrect decision. The soccer problem is 0%. They think that two kinds of events, whether they shoot or not, would occur with equal probability, and the probability was halved. In the left-hand problem, the subjective frequentist type had an appearance rate of 0%. This is based on my experience and a small probability of occurrence using a small sample. The anchoring adjustment type for the Soccer problem is 20%. They use subjective probability as an initial value and adjust the probability of an event considering the kicker's ability, pressure, and advantages/disadvantages of the situation. The soccer problem is most frequently used in the subjective case type, and the left-hand problem has the highest frequency type and the subjective frequency type.

Table 11
Marginal Effect: Linear Probits with each probability judgment type.

	(1)	(2)	(3)	(4)
Cumulative Total hours>hours target	-0.04 (0.009)	-0.038 (0.00672)	0.025 (0.034)	0.031 (0.033)
Cumulative income>income target	0.138*** (0.020)	0.058*** (0.018)	0.034 (0.054)	0.042 (0.050)
Cumulative Total hours	0.002*** (0.001)	0.002*** (0.001)	-0.001 (0.002)	-0.001 (0.002)
Cumulative Income/100	0.066*** (0.006)	0.091*** (0.006)	0.109*** (0.026)	0.094*** (0.022)
Case	-0.038*** (0.011)	0.003 (0.023)	0.033 (0.028)	-0.014 (0.024)
Frequentist	-0.059*** (0.008)	-0.029 (0.040)	-0.065*** (0.021)	-0.028 (0.040)
Subjective	-0.053*** (0.009)	-0.055** (0.022)	0.0001 (0.028)	-0.057** (0.024)
(Cumulative Total hours>hours target)*Case			-0.045*** (0.017)	-0.046*** (0.011)
(Cumulative Total hours>hours target)*Frequentist			-0.052*** (0.015)	-0.046*** (0.010)
(Cumulative Total hours>hours target)*Subjective			-0.066*** (0.010)	-0.057*** (0.007)
(Cumulative income>income target)*Case			0.102 (0.083)	0.009 (0.043)
(Cumulative income>income target)*Frequentist			0.038 (0.068)	0.007 (0.047)
(Cumulative income>income target)*Subjective			0.116 (0.088)	0.028 (0.053)
(Cumulative Total hours)*Case			0.002 (0.003)	0.002 (0.002)
(Cumulative Total hours)*Frequentist			0.003 (0.003)	0.003 (0.002)
(Cumulative Total hours)*Subjective			0.004 (0.003)	0.005** (0.002)
(Cumulative Income/100)*Case			-0.061** (0.027)	-0.002 (0.025)
(Cumulative Income/100)*Frequentist			-0.007 (0.030)	0.005 (0.027)
(Cumulative Income/100)*Subjective			-0.049* (0.027)	-0.013 (0.025)
Min temperature	Yes	Yes	Yes	Yes
Max temperature	Yes	Yes	Yes	Yes
Rainfall	Yes	Yes	Yes	Yes
Drivers	No	Yes	No	Yes
Day of week	No	Yes	No	Yes
Log-likelihood	-1355.22	-1274.1	-1342.62	-1267.87
Pseudo R2	0.169	0.219	0.177	0.223
Observations	19,637	19,637	19,637	19,637

The dependent variable is one if the driver stops daily work after customers get off, otherwise 0.

Robust standard errors in parentheses

*** p < 0.01,

** p < 0.05,

* p < 0.1

Table 12
Ave. experience(months) by type.

		Number	Ave.	Std.
Prob. Judg.	Case	17	40.522	18.992
	Freq.	27	43.105	20.009
	Subjective	10	44.857	19.903
	Fortune	5	27.461	13.89

In the Insurance problem, the anchorage adjustments type makes judgments about whether or not to take out insurance, considering the loss or anxiety about having 0%. The anchorage adjustments type decreased to 0% for the "overseas travel" problem that does not need decision-making. The frequency type had a low appearance rate of 13% in insurance but increased to 48% overseas. Including decision-making increases the judgments that adjust based on the objective and subjective probability as mooring points.

3.3.2. Frequentist type

In the problem that it is correct to use frequency-theoretic definitions, there is a more subjective case type: the misuse of probability definitions. In Soccer and left-handed problem, The probability of occurrence of two events, left-handed and right-handed, with or without a shot, is considered one-half, considering that it is equally likely. This bias tends to occur when asking for the probability of an occurrence for a particular trial or feature. In Dice Problem, they did not make a judgment based on the frequency-theoretic definition but made a case-type judgment. This is the same reason. It is considered that the frequency-theoretic definition is difficult to infer because it was impossible in 1000 or infinite trials in daily life. Also, it tends to be biased under decision-making conditions. If the respondent travels abroad and becomes more involved in certain situations, they do not judge based on the probability concept. It is, furthermore, being overly cautious due to anxiety and loss suffering a disaster. Limited information available becomes a mooring point and makes optimistic predictions.

3.3.3. Fortune type

A bias may be based on non-arithmetic that certain events will depend on luck. For example, the watches problem is 42%, the insurance problem is 17%, and overseas trips are 15%. This type is common when it cannot be based on a frequency-theoretic definition and cannot infer mooring points.

3.4. Relationship between self-reported reference points and probability judgment type

This subsection shows the relationship between the self-reported reference point and probability judgment type. In addition, it shows whether self-reported reference point correlates with probability judgment types.

Table 3 shows the relation between the above reference point and probability judgment type. For respondents, Self-Reported Reference Points can be one of three types: labor hour, income, labor hour, and income.

The summary description of Self-Reported Reference Points is 13, 21, and 25 in the bottom row. Cab drivers can choose one of three goals to stop working: if they exceed the target hours of work (labor hour), only if they exceed the target amount of daily income (income), or if they exceed both the target hours of work and daily income (labor hour and income).

The ratio of the type which chooses only labor hours is about 22%. The rate of the type which chooses income is about 36%. Rest is both daily income and daily hours. Drivers are most likely to value both labor hours and income. Regarding owner taxi drivers who targeted daily income in the past, if we work a long time, there is also the day which cannot reach the targeted income. Chi-squared test's results are significant at 1%, 45.833.

We have been anticipating daily income or first-hour income based on the experience, such as week and weather. Table 4 shows a correlation between Table 3. Self-reported labor hour type is at 1% significant positive with Frequentist. Their type is at 1% significant negative with Subjective and Case. Drivers who answered "only income" as the reference point are also significant negative with Case type and Frequentist type.

Most drivers with labor hours and income as a reference point are at 1% significant negative with Frequentist and Subjective type. Self-reported labor hours and income type are at 1% significant positive with Case and Fortune type. Their results mean the reference dependence correlates to probability judgment.

3.5. Relationships between reference dependence and rationality

3.5.1. What is the rational-experienced index?

When taxi drivers think about the probability when an uncertain event happens, it confirms that each type of probability judgment means different personalities regarding their rationality and their intuition. It means that the probability judgment type relates to their personality about rationality and intuition. Also, the probability judgment type may describe their rationality, intuition, and the number of reference points. We also questioned taxi drivers about Rational-Experienced Inventory (REI). The questionnaire, which is the rational-intuition index, consists of rationality and intuition questions. Cognitive-Experiential Self Theory (CEST) is a dual process. The theory was developed by Epstein (1994) to integrate multiple perspectives on personality.

The method specifies that people process information through two qualitatively different cognitive systems: a preconscious experiential system and a conscious rational system (Shirzadifard et al., 2018; Schutte et al., 2010; Marks et al., 2008). The Rational-Experiential Inventory (REI) and its derivative, the REI-40, began as a construct validation investigation of CEST. Four subscales characterize the REI-40: Rational Ability, Rational Attitude (Engagement), Intuition (Experiential) Ability, and Intuition Attitude (Pacini and Epstein, 1999). Subscale scores are computed by averaging the ten composite items. Administered via paper, the measure employs a 5-point response scale ranging from 1 to 5.

Table 5 shows descriptive statistics about REI. There is a difference in each rationality, even if it obey rational expectation. Epstein et al. (1996) investigated the credibility and reliability of REI. This paper also examines the relation between REI and four indexes; ambiguity tolerance, self-esteem, social desirability, and logical intentionality. It confirms the correlation between REI and four indexes of personality to test the reliability of the Rational Experienced Inventory.

Ambiguity tolerance means a personality that tends to fear ambiguous events. Lower avoids a confusing situation such as a world without rules. Intuition suggests the character that manages to find a prediction and is controlled by intuition in the above confusing situation. So, it expects to have positive significance with the intuitional operation. Logical intentionality measures the degree to which the value of rationality and logic of the six values think he is essential. It expects to have positive significance with rationality. Self-esteem is an emotional evaluation. Needs to sustain self-esteem motivate their rational and intuitional operations (Epstein, 1994). So,

it expects positive relationships with rational and intuitional operations. Social desirability should not be related to rational and intuition. If the attitude to their social desirability does not influence their answer, the above index should be reliable as it shows their personality. The ambiguity tolerance index consists of 13 questions from 5 choices that use Ambiguity Tolerance Scale (MSTAT-II), which McLain (2009) made. A high score means high Ambiguity Tolerance. The logical intentionality index consists of 12 questions from 5 choices. That uses logical intentionality, which Sakai and Hisano (1997) made. A high score means high logical intentionality—self-esteem index, suggested by Rosenberg (1965), consists of 10 questions from 4 choices. A high score means high self-esteem—social desirability index (BIDR), suggested by Paulhus (1991), from 2 choices. A high score means high social desirability. Lower Table 6 displays summary statistics by ambiguity tolerance, Logical-Intentionality, Self-Esteem, and Social Desirability. Table 6 also displays Cronbach to check internal validity for all variables.

3.5.2. Reliability of REI

This confirms about internal reliability of REI.

Table 6 shows the correlation between REI and the following four indexes; ambiguity tolerance, self-esteem, social desirability, and logical intentionality Naito et al. (2004).

Ambiguity tolerance is not significant with rational ability and attitude. It is significantly positive with intuition ability and attitude. Drivers who have high intuition ability or value intuition, even if they feel unclear or ambiguous, do not feel displeasure much. The logical intention is not significantly positive with rational ability and attitude. It is significantly negative with an intuitive attitude. So, drivers who value rationality do not value intuition, and drivers with high logical intentions also have high rational ability and attitude. Self-esteem is significantly positive with intuition ability and attitude. The higher the self-esteem, the higher the intuition ability and attitude. Social desirability is not significant with all variables. This is consistent with previous research. It means they do not think about who wants to take social desirability behavior when drivers decide on behavior. It confirms that REI is reliable as an index of rationality and intuition.

3.5.3. Correlation of probability judgment type and REI

It confirms that their cognition to Rationality-Intuition influences probability judgment type.

Frequency type is significantly positive with a rational attitude, and intuition attitude.

The subjective type is significantly negative with rational ability and attitude. This type is significantly positive with intuition ability. Case type is significantly positive with rational ability and attitude. This type is significantly negative with an intuition attitude. Frequency type value intuition. The fortune type is significantly positive with an intuition attitude. Case type makes rational expectation based on rationality. The subjective type makes rational expectations based on intuition. This type does not value rationality. The fortune type makes rational expectations based on intuition.

4. The empirical model

To implement the model empirically, I first define a latent variable C_{ijt} for the driver I on.

shift j after trip t that represents the forward-looking expected value of continuing to drive (the continuation value). An empirical representation of this latent variable is

$$C_{ijt} = X_{ijt}\beta + \delta I[Y_{ijt} < T_{ij}] + \varepsilon_{ijt} \tag{1}$$

where T_{ij} represents the reference income level for driver I on shift j , Y_{ijt} represents the income level for driver I on shift j at trip t , X_{ijt} is a vector of variables that determine the difference between the current utility and the continuation value, β is a parameter vector to be estimated, ε_{ijt} is a random component with a standard normal distribution. $I[Y_{ijt} < T_{ij}]$ is an indicator function that equals one if accumulated income is less than the reference income level and equals zero otherwise, and δ is a positive parameter representing the increment to the continuation value when the reference income level is more significant than income.

The second term in Eq. (1) embodies the incremental utility value of income below the reference income level that could be earned by continuing to drive.

The driver I on shift j will continue driving after trip t if $C_{ijt} \geq 0$ and stop if $C_{ijt} < 0$. The probability of continuing conditional on T_{ij} is

$$P_{ijt}^c | T_{ij} = \Phi[X_{ijt} + \delta I[Y_{ijt} < T_{ij}]] \tag{2}$$

where Φ is the standard normal cumulative distribution function.

If the reference income T_{ij} level were known, this specification would imply the usual probit.

model, and estimates could be derived by maximum likelihood in the usual way. However, the reference income level is unknown and must be estimated. Suppose the reference income level is

$$T_{ij} = \theta_i + \mu_{ij} \tag{3}$$

where θ_i is an individual mean reference income level, and μ_{ij} is a random component distributed normally with mean 0 and variance σ_μ^2 . The μ_{ij} represents daily deviations from θ_i in the reference income level, type of probability judgment, and the degree of rationality,

which determines income earned. We have used Crawford and Meng's (2011) model, following Koszegi and Rabin's (2006) in conceptualizing the income and hours targets as rational expectations. For simplicity, we assumed that they were point expectations.

5. Estimation of the labor supply models by probability judgment type

5.1. Descriptive statistics for labor supply

This section estimates using original data to analyze our hypothesis and show results.

Table 8 shows summary statistics about questions of labor supply.

Regarding the reason for quitting work, I questioned three choices; only daily work target, only daily income target, and both daily work target and daily income target. Reference points are determined from the three options. Appendix B provides the survey items for probability determination. In addition, appendix B lists the labor supply survey items for cab drivers.

5.2. Data overviews

In this subsection, we will use data on trip sheets of Tokyo City taxi drivers to explore the relationship between the hours drivers choose to work each day and the average daily wage.

We asked taxi drivers to fill out a questionnaire. Drivers filled out a questionnaire during each shift. Each sheet lists the driver's name, hack number, date, and trip details. The information for each trip includes the start time, end time, and fare.

In Tokyo, we interviewed and passed the questionnaire to owner-drivers at Akabane Station, Nerima Station, Shinkiba Station, Hachioji Station, etc. After we interviewed and passed the questionnaire to owner-drivers, we called about blank questions on owner-drivers he had sent us and on owner-drivers who provided trip-by-trip information for more than 20 days.

This study covers 4916 trips made by 59 drivers. This dataset, collected from the interviews, provides detailed information on individual drivers' characteristics, including education history, age, and experience length as a taxi driver. We also interviewed drivers about probability judgments. Each driver pays for his fuel and keeps his entire fare income. In Japan, owner-driven-cab, the driver has been a non-accident driver for ten years at another taxi company.

Many owner taxi drivers in Japan have Signed of Snails or lanterns written on the cabs' roofs. It means that the driver is a private cab driver group member. Snail mark means national private taxi association, and lantern mark means Japan private taxi association. We gave the driver a survey form covering January 2017 through December 2017. They generally buy their car in Japan. We additionally collected data from the Japan Meteorological Agency on temperature and rainfall in the Nerima area, around the Tokyo station area. We collected hourly data, minimum and maximum temperatures, and rain but could not get weather data from them. So, we used daily weather data.

We performed several regularity checks to ensure that the trip sheets were internally consistent, and where they were not, the data was cleaned using a set of reasonable rules.

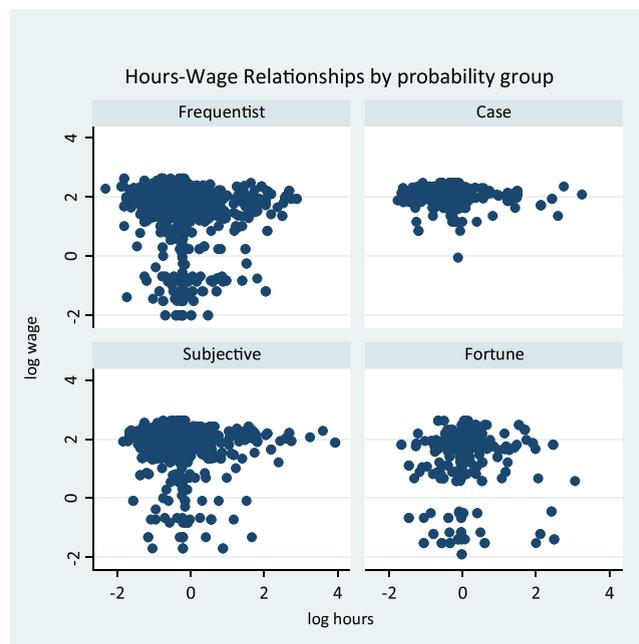


Fig. 1. Hours-Wage Relationships by probability group.

These rules are such as Farber (2008) Appendix A. This data performs several regularity checks to ensure that the trip sheets are internally consistent, and where they are not, the data was cleaned using a set of reasonable rules. The process is outlined here. The primary consistency checks are that (1) trips must start no earlier than the end of the previous trip, and (2) trips must start before the end (have a definite duration). We coded the starting and ending locations on the trip sheets into Station, the nearest station, National and Prefectural route number, downtown, midtown, uptown, airport, Etc. Almost all trips started and ended at the Station. We collected data from the Meteorological Bureau on temperature and rainfall in Tokyo. We collected daily average, minimum, and maximum temperatures and collected hourly rainfall and temperatures. We calculated the simple correlation between (log) hours and (log) wages for each probability judgment type. The upper left displays the frequentist type. The upper right shows the Case type. The lower left shows the Subjective type. The lower right shows the Fortune type.

In Fig. 1, Frequentist, Case, Subjective, and Fortune-type statistics are -0.15 , -0.11 , -0.05 , and -0.03 . Fig. 1 shows the scatterplots of log hours and logs wages in the four probability types, which are the negative correlations. A total of 4916 trips are listed for the 491 shifts for the 59 drivers in the sample. The data is available for, on average, 8.32 shifts, a minimum of 3 shifts, and a maximum of 13 shifts per driver. The standard deviation is 2.90. Hours worked per day. Fig. 2 contains the distributions of hours.

Fig. 3 contains kernel density estimates of the distributions of fares. The average fare for each trip is 18.76. There is substantial variation across drivers in average hours worked per day, with means ranging from 13.08 to 24.67. The standard deviation of average hours worked per day is 2.22. The mean is 18.5.

The average income is 117.28. There is also substantial variation across drivers in total fare income per day, ranging from 58.69 to 166.27. The standard deviation of daily income is 28.1. The mean is 112.79.

Fig. 4 contains kernel density estimates of average daily income.

In income, the difference between the probability judgment type is enormous.

5.3. Probit estimation of the labor supply each probability judgment type

We estimated linear probit models of the probability of stopping in Crawford and Meng (2011), but splitting the sample, shift by shift, according to a driver's earnings for the first hours of the day. It is the model about stopping probability, with dummy variables to measure the increments due to hitting the income and hours targets as in Farber's (2008) Table 2, but with the sample proxies for targets introduced above instead of Farber's estimated targets.

Farber (2008) showed that the reference dependence model is significant with the income target model. This index function has the value of one when real income is lower than the income target to decide about the daily work hours. The above aligns with Camerer et al. (1997), but the income target is significantly positive, and its variance is large and unstable. Crawford and Meng (2011) found that the daily hour of the owner-driver is determined by rational expectation. They investigated owner-driver and made the reference point of income target or hour target by whether the real income of the driver who worked at short hour reached the income target at the short hour.

The driver makes the daily average income or the average daily hour of the week the same as the day he worked as the reference point. They divided the sample by whether the first hour's realized earnings were lower or higher than the first hour's expected earnings. Using the split data, they used a probit model to estimate the probability that the driver would stop the daily labor. The drivers stop their daily work when they reach the income target if they realize their earning is lower than expected. They find a significantly negative relationship between labor hours and income. Drivers stopped their daily work when they reached the hour target if they realized their earning was higher than expected. If the driver reaches both the income target and daily hour target, stopping probability happens to be more strongly influenced by the second target a driver reaches than the first target. The questionnaire can include a Daily sales target and Daily hours target to be set by the respondent daily. All of the work-hour goals and income goals may be listed. However, only one of them may be stated.

This paper uses the original data of each customer and each driver. Table 9 reports probit estimation. It includes a dummy variable, one if real income reaches the target income, and one if real hour reaches the target hour as the explanatory variable. Their variables mean reference points, including the daily hour and income as level variables. Table 9 includes the above variables. Table 10 adds the daily minimum temperature, max temperature, weather, driver ID, and the week of the day.

The probit estimation results using all sample is significant with two target variables. All sample and frequentist types have two targets as reference points. Case type is significant positively at income target and hours level variable. Frequentist type is significant positively at two target variables and hours level variables. Subjective type is significant positively at income target and one level variable. Fortune type is insignificant at two targets. However, it is significant positively at the hours level variable.

5.3.1. Probit estimation, which includes some variables

In Table 10, Case type is significant at hours level variables and income target. This type has one target as the reference point.

Judgment based on experience implies changing the reference point based on new information. It implies Bayesian inference. It may update prediction probabilities using daily information updates based on experience, and the change of prediction probability makes new goals again. New goals may make a new reference point. Frequentist type is significant about hours target and hours level variables. It is significant at two targets for the frequentist type in Table 9. Under uncertainty, the frequentist type uses reference dependence to make decisions because it accepts averages. The subjective type has two-level variables and an income target. The subjective image determines the probability that the real income will reach the daily income target.

Fortune type (5) equation is significant with one level variable and one target variable, but it is significantly negative with the target variable. When an uncertain event occurs, they probably attribute the reason to luck and not a probability. Fortune types are less

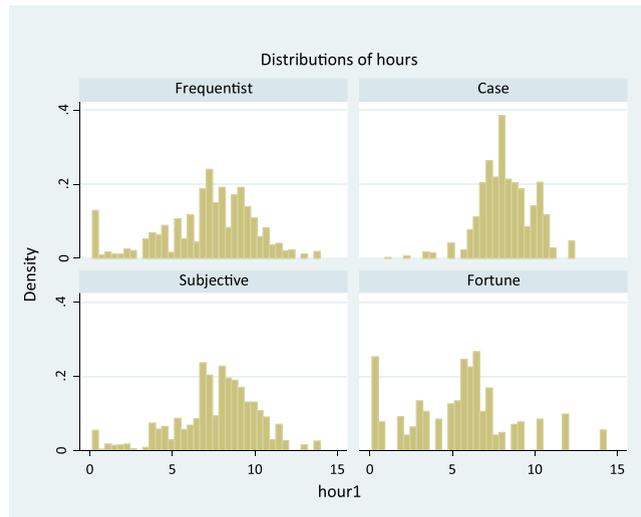


Fig. 2. Distributions of hours.

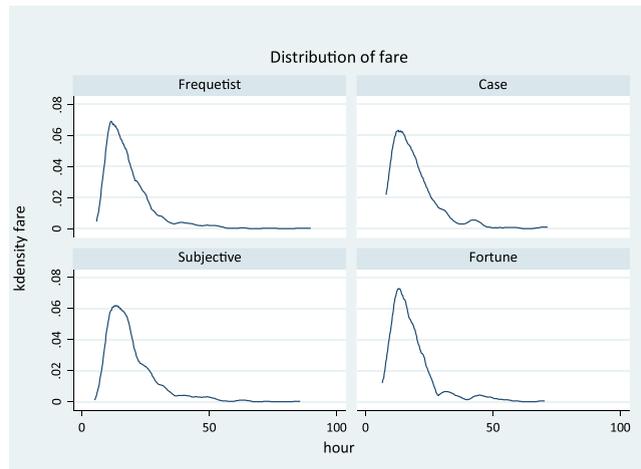


Fig. 3. Distribution of fare.

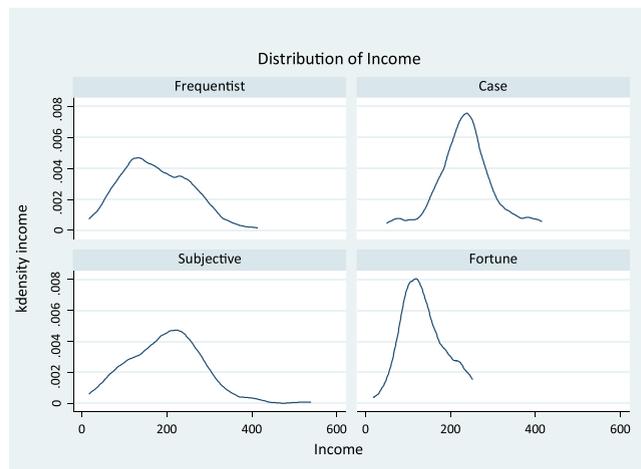


Fig. 4. Distribution of Income.

experienced cab drivers than other types. They may not have been able to do rational expectations yet. The analysis confirmed that people of the Case, frequentist, and subjective types make decisions based on rational expectations and have a reference point.

5.3.2. Probit estimation, which includes probability judgment type

Table 11 shows estimation results that include the type of probability judgment and the interaction term between the probability judgment type and the reference point using pooled data as explanatory variables.

As a result of including probability judgment types, Eq. (2), including driver ID, was only Subjective significant. In contrast, Eq. (1), which does not include the driver's ID, is negative and significant for all probability judgment types. The interaction term is not significant for the Cumulative income > income target variable, the income target variable.

All interaction terms for Cumulative total hours > hours target, the target variable for hours worked, are significant. The cross term for the level variable Cumulative Total hours worked is significant only for the Subjective in equation (4). The cross terms for the level variable income, Cumulative Income/100, were significant for Case and Subjective in Eq. (3).

Although the reference point becomes insignificant when the cross-term is included, it confirms that probability judgments affect labor supply.

5.3.3. Expectation and probability judgment type

When taxi drivers anticipate daily income, drivers must have some experiences which worked in the area as taxi drivers to make rational expectations.

In Japan, owner-drivers need to have experience of more than ten years as taxi drivers. So, below Table 12 confirms the experience years as a driver in Tokyo, not experience years as a taxi driver. Fortune type has shorter experience years than others. Drivers make rational expectations based on their experience as taxi drivers in Tokyo. Fortune type may also have target variables even if they have more experience years.

6. Discussion

This paper provides empirical evidence that probability judgments help explain a reference-dependent preference for Tokyo taxi drivers. The type of probability judgment explains the number of reference points and confirms why probability judgment types are related to reference dependence. Probability judgment types are related to drivers' personalities (Rational-Intuition). It means that the degree of rationality influences reference dependence on decision-making. The difference between cognition to rationality, of consciousness, which tries to act rationally, determines their reference dependence type.

Further studies would be required to include some index using some psychological personality tests. It is unclear whether it is a simultaneous decision or a causal relationship about relationship between the reference point and the probability judgment when they decide their behavior under uncertainty.

This study's results suggest a causal relationship between reference points and probability judgments and that probability judgments determine reference points. The results also suggest that the differences in perceptions of rationality affect the differences in decision-making. These are consistent with the results of previous studies where reference points are made by their expectation. The perception of rationality affects the decision-making process. It depends on the process of forming expectations based on rationality. However, this means that not everyone with the same information will make the same decision. The results of this study show that differences in perceptions of rationality may form a reference point in the decision-making process depending on expectations. They suggest that the difference in decision contents is that the processes of forming expectations are not based on the speed of expectation formation but on the attitude and the ability to rationality. It suggests that the expectations formation process is qualitatively different. But it is not clarified whether the decision-making process changes as the degree of uncertainty increases. The expectation formation process has the possibility that the reference point is not unique because of the difference in the perception of rationality, and the difference in the perception of rationality may form a different reference point or have multiple reference points. Even if the reference point has a low degree of awareness of rationality, the position and the variance of the reference point gradually may become consistent with everyone because of not only the rationality but also the predictability through an analogy that can give from increased experiences under uncertainty, as seen in REI. Even though the reference points seem unique for almost everyone, this study shows that this is not necessarily. It determines future behavior based on the experience for those who value the experience and based on rationality for those who value rationality. It is assumed that an individual's learning process under uncertainty depends on the difference in probability judgment. In the previous review about probability judgment, women emphasize experiences, while men emphasize rationality (Sladek et al., 2010). Many can accurately calculate if they have a strong willingness to judge reasonably and excellent numerical processing ability to calculate. A certain number of those have a strong attitude to judge but insufficient numerical processing ability. Even they can apply their own experiences and the experiences of others under uncertain events they face. In order to maintain a certain level of accuracy in prediction, a certain amount of information, experiences, and adaptive power are required. However, even those who want to judge based on the experience by emphasizing experience, some do not have sufficient information volume, information utilization ability, and adaptability. REI is a measure of general rationality used in health psychology and communication fields. Heuristics have similar phenomena for many people, but the probability judgment reflects various personalities, and the probability judgment is also related to the number of reference points. The results of REI vary from person to person, so it reflects not only the perception of rationality but also the perception of experience. CEST's dual cognitive system makes a difference in REI. Like preferences for products and foods, REI also affects subjective well-being and emotions. REI can categorize the process of forming reference points, and REI also affects subjective well-being and emotions and may affect reference points. Future research is

needed. It is known that emotions influence decision-making to a certain extent, but the relationship between REI and emotional decision-making is unclear. Emotions do not mean rejection of rationality, and Many people tend to make a reason after looking at the results. As a result, derived from that reason, there is a tendency to take the obtained results. As confirmed by heuristics, after seeing the results, people consciously change important information and the degree of importance so that they can understand. As mentioned above, the change in consciousness after seeing the results is not always appropriate and consciously alters important information to be understood. For those who are likely to have a disgust for a specific behavior or substance or who tend to think critically, the emotions which arise when above thinking will affect the evaluation of facts and results. As a result, future decisions may be different from others. People likely to have disgust, favor, and criticism tend to form reference points based on their experience. Even if multiple reference points are formed, the priority of the reference points is different by probability judgments. This study is the first to use REI to confirm that probability judgment affects the order of priority of reference points and that emotions and experiences affect decision-making through reference points.

Declaration of Competing Interest

I have no pecuniary or other personal interest, direct or indirect, in any matter that raises or may raise a conflict with my duties as a manager of the Incorporated Management Committee of Business Breakthrough University

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.asieco.2023.101613](https://doi.org/10.1016/j.asieco.2023.101613).

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