An Agent-Based Simulation of Contents Industry
- The Influence of Personality Factor on Decision Making in Gambling Behavior-

M. Matsumoto and *H. Lee (Shizuoka University)

Abstract There are various gambling such as pachinko, horse race, lottery in contemporary Japanese society, which are enjoyed as entertainment, also cause social problems like gambling dependence. In this research, we conducted a questionnaire survey to investigate the personality characteristics, decision-making in gambling behavior. In addition, we prepare a simulation model based on the questionnaire results to examine the relationship between personality factor and possibility of gambling dependence and find out scenarios to decrease gamble dependence.

Keywords: Gamble Dependence, Personality Factor, Scale of Risk Acceptance, Regret and Maximization Scale, Agent-Based Simulation

1 Introduction

Gambling has existed in human life and has been widely popular as people's entertainment. Among modern societies, there are various types of gambling such as pachinko, lottery, horse race, bicycle race, boat race, auto race and so on. But on the other hand, it causes social problems such as gambling dependence that makes troubles economically, socially and mentally.

Gambling addiction is also defined as a mental illness at WHO and the American Psychiatric Association. The diagnostic name "pathological gambling" is used in diagnostic guidelines of WHO(ICD - 10). People cannot control himself when it gets gambling addiction, and debt from the consumer finance, unemployment, domestic discord, divorce, DV, neglect, depression[1].

However, measures against gambling dependence tend to be delayed in Japan, and it is rare for the administrator to handle care on gambling addiction. In many countries other than Japan, the management side is in charge of measures. For example, in the United States, "Responsible Gambling" in which casino contractors take measures against addiction is necessary. There are also many support organizations for gambling addiction patients by private and nonprofit organizations, and casino operators are donating to these organizations. [2]

Countermeasures against gambling addiction are being implemented in various parts, such as establishing a consultation window in the casino and executing an educational program on dependency problems for employees and customers. Apparently, the higher proportion of gambling addiction in Japan is caused by lack of measures against gambling addiction. In order to lower the prevalence rate of gambling addiction in Japan, it is considered necessary to take measures against such gambling addiction and strengthen care for addictive patients.

On the other hand, by incorporating the gaming industry such as casino into the country, it can be expected to produce a great economic effect. For example, in the United States, tax revenues in each province got sluggish after the First World War, and in 1929 a major stock market crash and the economic downturn in the United States. The casino of the gaming industry actually resulted in economic effects such as increased tax revenue and creation of employment. [3]

Conventionally, various psychological studies have been conducted in gambling. For example, research on decision-making about risk-taking behavior including gambling [4], research studying the relationship between personality characteristics and situation[5][6][7], research on the perception of luck [8], or research on pathological gambling [9].

In previous research, personality characteristics and circumstance factors, previous win and loss and emotional state are factors affecting the recklessness and handiness of gambling behavior and betting. Therefore, in this research, we conducted a questionnaire survey to examine the personality characteristics of individuals and the decision-making in gambling behavior based on their relevance. In addition, we create a gambler model based on the questionnaire result, designing a simulation of a casino (gamble game). We will verify the relationship between personality factors and gamble dependence, and find out scenarios to decrease gamble dependence in this study.

2 Questionnaire survey and Analysis

In this questionnaire, to measure personal personality characteristics of individuals, "Scale of Risk Acceptance (SRA)" and "Regret and Maximization Scale (RMS)" are used. We ask fifteen items of questions on SRA, fifteen items on “Regret and Maximization Scale”, and we asked each item by 4 items of "1.strongly agree" to "4.absolutely disagree" for an answer.

We also assumed several question items in various gambling scenes. We use 'Large and Small' which is a easy dice game.

'Large and small' is a gamble that predicts the total number of outcomes by using three dice. If the total of the numbers is four to 10, it is "small," if it is eleven to seventeen it is "large". However, when the dice is three-pronged, it does not apply to either "large" or "small". Players can expect whether it is "big," "small" or "matching dice." When "big" and "small" hits dividends are doubled, and the dividend of " matching dice " is thirty times. Expected gains of "large" and "small" are 97.22%, and the expected gain of "matching dice" is 83.33%.

Participants start “large and small” with 100 dollars. It is possible to play up to twenty-four games until there is no money to be withdrawn, also that the game can be canceled halfway at his/her favorite timing. Also gambling "small amount," " normal," " large amount," " full amount," "pass (now only game watching only)" and "canceling game (de-

 PG0002/17/0000-0099 © 2017 SICE

scending from a bet)" are also introduced. We prepared several questions about the decision assuming multiple situations. The choices of respondent are as Table 1. And the detail of survey is as Table 2.

Table 1 Decision making table

	Big	Small	Matching dice
Small amount			
Normal amount			
Large amount			
Full amount			
Pass			
Quit			

Table 2 Detail of Survey

Survey	Detail
Target	91 students of Faculty of Engineering and Information Science in Hamamatsu Campus of Shizuoka University. (60 Male and 31 Female)
Date	November 29, 2016

Factor analysis by main factor method and Varimax rotation was carried out on Scale of Risk Acceptance (SRA), and the results are shown in Table 3. Therefore, the first factor was classified as "safety first," the second factor was "reckless," the third factor was "cautious," the fourth factor was "challenging," and the fifth factor was classified as "balance". The results are as same as SRA.

Table 3 Factor analysis on SRA

Questions	f1	f2	f3	f4	f5
1 I do not like anything scary	**0.71**	−0.08	−0.09	−0.08	−0.08
2 Absolutely not approach dangerous places	**0.67**	−0.20	0.19	0.01	−0.07
3 Everything is safe first	**0.74**	−0.21	0.25	−0.02	−0.11
4 Adventure without thinking about your competence	−0.25	**0.67**	−0.19	−0.12	0.14
5 I have begun to realize there are things that can be adventurous	−0.08	**0.69**	0.05	0.13	0.13
6 People sometimes told you it's dangerous	−0.14	**0.65**	−0.07	0.04	−0.10
7 Respond cautiously to everything	0.15	−0.25	**0.56**	0.31	−0.04
8 The difficult problem does not start unless we have to see the whole thing	0.01	0.14	**0.69**	0.00	0.10
9 Carefully advance things everything so as not to fail	0.13	−0.14	**0.68**	0.03	0.06
10 It is more challenging to have difficult problems	−0.08	0.01	0.06	**0.64**	0.13
11 I like to challenge new things	−0.15	0.23	−0.27	**0.33**	0.20
12 I want to adventure without giving up to the end even if it does not go wrong	0.03	0.03	0.10	**0.66**	−0.06
13 It is no use dangerous for every event in the world	−0.13	−0.04	0.11	0.12	**0.61**
14 It is life to deal well with danger	−0.14	0.28	0.04	0.14	**0.50**
15 Because the danger and safety are mixed together, the world is established	0.02	0.00	−0.02	−0.08	**0.56**
contribution	19.30	10.70	6.20	5.80	5.00
Cumulative contribution	19.30	30.00	36.20	42.00	47.00

Table 4 Factof analysis on RMS

Questions	f1	f2
1 It is often that it was good if you had made something different after purchasing	0.64	−0.07
2 There are many things you regret after buying it even if you have difficulties in selecting items	0.60	−0.28
3 It is common to think that it was ″I should have done so″ against what has passed.	0.60	0.09
4 Even if the goods purchased are good, there are many times I often think that ″there would have been better ones″.	0.65	0.03
5 In my life, I often think that ″I should have done it at that time″	0.54	−0.03
6 When purchasing a certain item, there are things I regret thinking about the possibility that there was a better product	0.74	0.10
7 I regret to reply to the past	0.56	0.07
8 I think that I am indecisive	0.34	0.15
9 As long as there is a possibility, I will not spare trouble to pursue things	0.16	0.37
10 When thinking about something, think about every possible choice	−0.02	0.73
11 I think shopping time and the time to select items are longer than others	0.14	0.50
12 Information collection, such as new products, trendy health laws, etc., is always indispensable	−0.10	0.23
13 Pursue thoroughly things such as favorite things, talent, singers	0.06	0.09
14 Even when you buy one thing, you often see it compared to other shops	−0.08	0.56
15 I want to try extreme in any hobby, it is a type of immersion	−0.01	0.28
16 When choosing an item I always try to choose the best one	0.02	0.55
contribution	18.00	11.30
Cumulative contribution	18.00	29.30

Another factor analysis by main factor method and Varimax rotation was carried out on Regret and Maximization

Scale (RMS), and the results are shown in Table 4. Therefore, The first factor was classified as "regret" and the second factor was classified as "maximization". The results are as same as RMS.

In this study, we used two scales, SRA and RMS, so we also examined whether there is a relationship between the two scales. Therefore of seeing the correlation between the two scales, positive correlation was found between "maximization" and "cautious," "maximization" and "challenge". Maximization people are seeking higher satisfaction are considered to be cautious and challenging personality.

Principal component analysis was conducted on decision making questions (Q 3 to Q 12) of gambling games. Here, we classified the wager amount (small amount, ordinary amount, large amount, full amount) or passed / cancellation. Table 5 shows questionnaires of questionnaires Q3 to Q12. The contribution rate to the ninth principal component was 54.6%.

The first principal component does not make a large bet after victory and cancel in every situation, so "abort". The second principal component plays an ordinary amount and does not make a small bet, so "normal bet." The third principal component is "bullish bet" because it places a large amount of bet and does not bet the normal amount. The fourth principal component is to "lucky full bets" to make a full bet after victory. The fifth principal component is "bearish bet" because they make a small bet after winning streaks and losing streaks. The sixth principal component performs a bet after defeat or a small amount bet, and after betting the winning stake a small bet is made, "bearish appearance." The seventh principal component is "aiming at one shot" to make a full bet after a losing streak or after a sticky eye. The eighth principal component is a pass after seven consecutive loses, "losing consecutive defeat" because it does not stop. The ninth principal component was classified as "Wait after consecutive winning" to perform a post winning pass.

Table 5 Questions

Number	Question
Q3	After one victory
Q4	After last defeat
Q5	After victory at one front eyes
Q6	After defeat with one front eyes
Q7	After 2 consecutive wins
Q8	After two consecutive losses
Q9	After 3 consecutive wins
Q10	After 3 consecutive loses
Q11	After 7 consecutive wins
Q12	After 7 consecutive loses

According to the correlation analysis of personality characteristics and gambling behavior (Q 3 to Q 12)

Safety first oriented people choose to cancel when the losing streak continues, those who are recklessly intentioned make a full bet, people with high pursuits predict "matching dice" after winning the winning streak It is considered that it was a reasonable result, taking the gamble behavior as the name of personality factor.

For each personality factor, relevance to the previous victory / defeat situation, personality characteristics and gambling behavior were seen, especially among those with low safety first mind, highly reckless people, challenging oriented people. It is easy for them to make a large or full betting after the winning streak and the losing streak continue, and it is easy to immerse into gambling.

Even in correlation analysis by principal component scores and personality scores, a cautiously oriented person gave a small amount of betting, and people with low challenge orientation selected stopping when the losing streak continued roughly reasonable results were observed.

3 Simulation Model

To grasp what type of personality person is immersed in bankruptcy and what type of gambling system design will make it possible to gamble to an extraordinary degree without failing, We constructed “large and small” gamble simulation models based on the questionnaire data by SOARS.

To construct a simulation model of “large and small” games, a virtual casino is required. In this model, virtual casino is offered by combining gambler 's betting behavior and betting amount setting, result of large and small game, dividends setting etc.

91 people answering the questionnaire were set as gambler agent in this model. Each gambler 's initial holding amount is 100 dollars. When the winning streak or the losing streak actually continued, the rule was written to take the behavior as asked by the questionnaire Q 3 to Q 12. If the situation is not applied, the betting (large, small, matching dice and pass) and the wagers (small amount, ordinary amount, large sum, full amount) are random. The probability is calculated by average values of all answer items of questionnaire respondents. Table 6 and Table 7 show the betting by random and the probability of wagering. The expected gain at the random strategy was 96.2%.

Table 6 Betting under random strategy

Betting	Probability
Big	43%
Small	41%
Matching dice	9%
Pass	7%

Table 7 Wager under random strategy

Wager	Probability
Small amount	39%
Ordinary amount	34%
Large amount	23%
Full amount	4%

Also, one dealer is there, and each game is given a result of "large" with a probability of 105/216, "small" with a probability of 105/216, "matching dice" with a probability of 6/216.

If gambler wins, he/she gets a dividend according to the wager. There were four kinds of bet amount: "small amount (5 dollars)," "normal (10 dollars)" "large amount (40 dollars)" "full amount (money held)." If "Large" "Small" expectation comes true, the dividend will be doubled, and if the forecast is hit at the "Matching dice," the dividend will be thirty times.

The gambler shall have the result status of "complete victory," "victory," "defeat," "complete defeat" or "bankruptcy" whenever the game ends. If it is over 100 dollars, it is "victory," if it is less than 99 dollars it is "defeated". If that gambler increases to the amount in Q1 "complete win," when amount fell to the amount in Q2, it was "complete defeat." Also, when his own money falls to 0 dollar, it is "bankrupt".

We conduct the model in SOARS simulator. Figure 1 shows the model and Figure 2 shows the stages in SOARS. There are two agents, three roles, and twelve spots in the model.

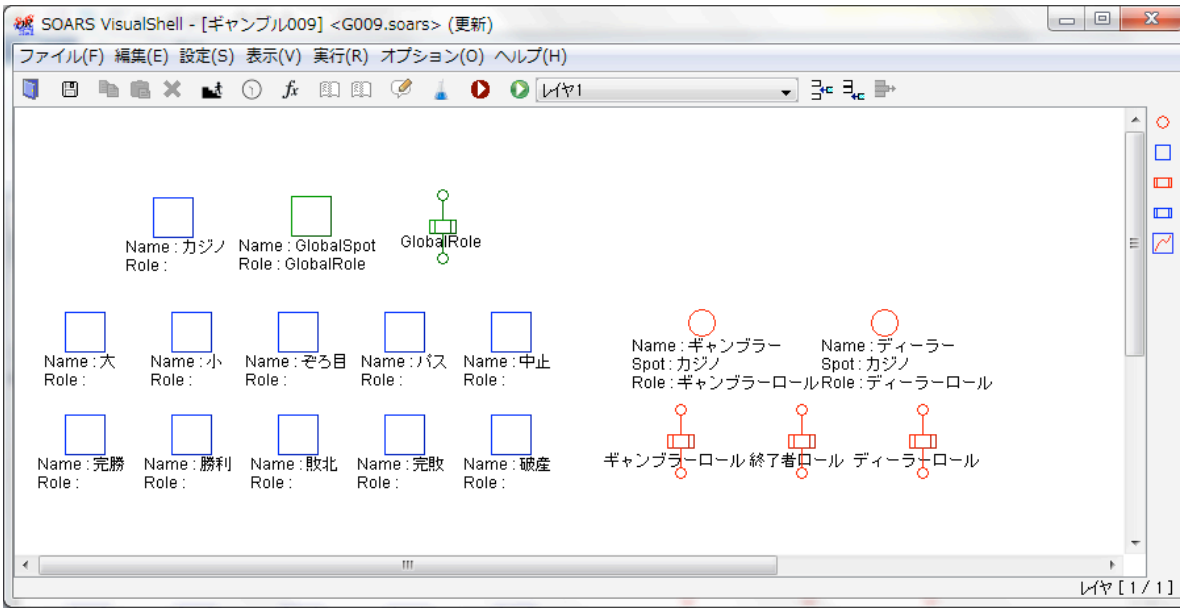

Figure 1 SOARS Model

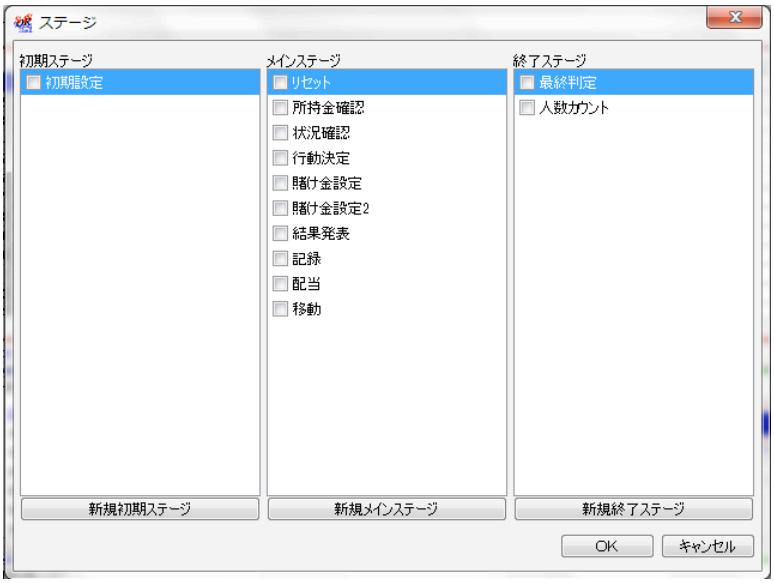

Figure 2 SOARS Stage

4 Simulation Results

Simulation was carried out one hundred times, and the correlations between the score of each personality characteristic and victories, defeats, complete defeats, complete defeats, bankrupt was investigated. Therefore, a positive correlation (correlation coefficient 0.31, 1% significant) was seen in "safety first score" and "number of bankruptcy." Bankruptcy is higher when gambler is with lower safety first priority.

Furthermore, we asked for the proportion by giving the average number of people of one hundred times how many people were in each result. The results are summarized in Table 8. Victory resulted in 29.5%, defeat at 31.2%, complete victory at 9.1%, complete defeat at 19.5%, bankruptcy at 10.7%.

Also, the average value of the final holdings of ninety-one gamblers is 96.6 that almost converges to 96.2, the expected gain at the random strategy by Table 6.

Further, simulations were carried out for a total of 1,000 times. Because of examining the correlation, a positive correlation (correlation coefficient 0.33, 1% significant) was found in "safety first score" and "number of bankruptcy" as in one hundred times analysis.

Also, we asked for the proportion by giving the average number of people of 1,000 times how many people were in each result. The victory was 28.9%, the complete victory was 9.6%, the defeat was 31.6%, the perfect defeat was 19.1%, the bankruptcy was 10.7%, almost the same result as the one hundred times analysis. In addition, the average amount of 1,000 final auctions of ninety-one people is 98 dollars, which is not much different from the expected value 96.2, like the one hundred times analysis.

Table 8 Simulation results

Result		Proportion (%)
Victory	Victory	29.5
	Complete victory	9.1
	Total	38.6
Defeat	Defeat	31.2
	Complete defeat	19.5
	Bankcrupt	10.7
	Total	61.4

Comparing one hundred times analysis and 1,000 times analysis, the result was almost unchanged. So the times of simulation will be set to one hundred for scenario analysis.

The scenarios are performed in this study will be "eliminate full betting," "eliminate large and full betting," "halve the maximum number of games," "restrictions for people with lower safety first," "restrictions for people with very lower safety first." These scenarios are based on the actual gambling addiction measures actually taken in other countries, such as setting the maximum amount on slot machines in Norway.

The results are summarized in Table 9.

Table 9 Simulation results of scenarios

Scenarios	Victory			Defeat			
	Victory	Complete Victory	Total	Defeat	Complete defeat	Bankrupt	Total
Normal	29.5	9.1	38.6	31.2	19.5	10.7	61.4
Eliminate full betting	29.7	8.8	38.5	33.5	22.3	5.7	61.5
Eliminate large and full betting	35.6	4	39.6	50.6	9.5	0.3	60.4
Halve the maximum number of games	31.9	7.7	39.6	38.4	13.8	8.2	60.4
Restrictions for people with lower safety-first	31.3	7.9	39.2	34.7	19.7	6.4	60.8
Restrictions for people with very lower safe-ty-first	29.9	9.6	39.5	31.4	20.7	8.4	60.5

(1) Eliminate full betting

For those who filled the full amount in the questionnaire items of Q 3 to Q 12, they take random actions The probability of 'small amount', 'normal' and 'large amount' was calculated randomly based on the average value of all items excluding "full amount." Therefore, the probability of small amount is 41%, ordinary amount is 35%; large amount is 24%.

How many people were in each result? The average number of people is calculated, and it was 29.7% in victory, 33.5% in defeat, 8.8% in complete victory, 22.3% in complete defeat, and 5.7% in bankruptcy. It is found that the ratio of bankrupt has decreased by nearly half.

(2) Eliminate large and full betting

For those who filled the full amount or large amount in the questionnaire items of Q 3 to Q 12, they take random actions The probability of 'small amount', 'normal' and 'large amount' was calculated randomly based on the average value of all items excluding "full amount." Therefore, the probability of small amount is 54% and ordinary

amount is 46%.

As the proportion of the result, it turned out that bankruptcy decreased greatly to nearly 0%, with 35.6% victory, 50.6% defeat, 4.0% complete, complete defeat of 9.5% and bankruptcy 0.3%.

(3) Halve the maxi-mum number of games

The maximum number of games in one simulation was reduced to twelve game, which is half of the normal number.

The average number of people in each result was calculated, and the percentage was 31.9% in victory, 38.4% in defeat, 7.7% in defeat, 13.8% in complete defeat, 8.2% in bankruptcy, and the ratio of bankruptcy was decreased slightly.

(4) Restrictions for people with lower safety-first

We set entry restrictions by using factor score of "safety first" which had a great relationship with "number of bankruptcy." A person with a safety first score of positive (0 or more) moves to the "admission restricted" spot before the start of the gamble game, since it can be considered that the safety first priority is lower as the score is exaggerated.

Therefore, forty-six people out of ninety-one people were admitted. Also, one hundred simulations were conducted and people in each result excluding "admission restriction" was calculated to get the average number of people for one hundred times, and it was 31.3% victory, 34.7% victory, defeat 34.7%, complete victory 7.9%, complete defeat 19.7 %, Bankruptcy 6.4%, and it turned out that the proportion of bankruptcy was lower than in the normal case.

(5) Restrictions for people with very lower safety-first

As in (4), entrance restriction was established by using factor score of "safety first" which was particularly related to "number of bankruptcy." Since the average value of safety first score of forty-six people whose entry was limited in the scenario of (4) and factor scores were 0.69, this time people with a particularly high first safety score (more than 0.69) move to the " admission restricted " spot.

So, twenty-two people out of ninety-one people were restricted entry. Similarly, one hundred simulations were conducted and people in each result excluding "admission restriction" was calculated to get the average number of people of 100, and the percentage was gotten. Victory 29.9%, defeat 31.4%, victory 9.6%, complete defeat 20.7 %, Bankruptcy 8.4%, and it turned out that the proportion of bankruptcy was slightly lower than in the normal case.

Comparing the scenario analysis, in any scenario, the proportion of bankruptcies is decreasing from the normal one. Especially, in the scenario (2) that eliminates large and full betting, the percentage of bankruptcy became almost 0%, but the proportion of winnings decreased and the proportion of defeat increased greatly. Altogether, about 60% of the people had decreased compared to the initial holdings, which were not much different from normal times and other scenarios.

5 Conclusion

The questionnaire survey showed that personality and gambling behaviors were related to each other. People with personality such as "safe first (low)," "reckless (high)" and "challenging (high)" that are easy to bet large or full after successive victories and successive losses in the personality characteristics also have high risk of gambling dependence.

In the simulation analysis, there is a correlation between "safety first" and "number of bankruptcy," people with low safety margin are frequent in bankruptcy. It is same as questionnaire survey.

The percentage of bankrupts will decrease in all scenarios. When casinos are established in Japan, setting of ceiling of amount and times of gamble or entry limit by personality characteristics should be considered.

By creating a behavioral model based on the questionnaire and an agent based simulation model of gambling, it was possible to get results beyond statistical analysis. Instead of carrying out the field experiments, it is more effective to create a model based on questionnaires and simulation. It is also effective for simple diagnosis of gambling dependence by individual personality characteristics based on the simulation result.

Acknowledgment

This work was supported by JSPS Grant-in-Aid for Young Scientists (B) Grant Number 26870720.

References

1) Tanaka Noriko: Gamble addiction Kadokawa Shinsho (2015) (in Japanese)
2) Housei Hahakigi: Gambling dependent country Japan · Mental illness beginning from pachinko Kobunsha Shinsho(2014) (in Japanese)
3) Nobukazu Shirai, Satoshi Saitou: On the usefulness of the casino to legitimize the regional economy. Bulletin of Sanno University 31 (2), 55-71 (2011) (in Japanese)
4) Hideo Kamiichi: Factors stipulating individual differences in personal risk-averse / avoidance behavior Kazama Shobo (2003) (in Japanese)
5) Hideo Kamiichi Takashi Kusumi: Influence of regret on decision making in risk-awareness and avoidance behavior: Process model of emotion, personality, cognitive factor Cognitive science 7 (2), 139-151, (2000) (in Japanese)
6) Motoi Niino: Examination of Personality Factors Affecting Gambling Behavior - Relationship with Big five and Other Personality Scales Applied Sociology Research 14, 105 - 128, 37 (2004) (in Japanese)
7) Taeko Ogawa · Yuko Minamizuka: Influence of Personality Factors and Situation Factors on Satisfaction of Gamble Game Tokai Gakuin College Bulletin 3, 113-118(2009) (in Japanese)
8) Takada Takahiro, Yukawa Shinta: Influence of victory or loss, emotional state, luck feeling on recklessness and handiness of gambling behavior Social psychology studies 30 (2), 132-140 (2014) (in Japanese)
9) Taeko Ogawa: Perspective of Psychological Research on Gaming Behavior (2014) Psychology Review 57 (2), 200-214 (2014) (in Japanese)