sustainability

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Time Discounting and Hand-Sanitization Behavior: Evidence from Japan

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Abstract: Whether non-compliance with hand sanitization is related to impatience or impulsivity is an unresolved issue. Several studies have argued that not maintaining hand sanitization requirements during a pandemic could relate to impatience or impulsivity. However, the impatience or impulsivity of hand sanitization needs to be investigated in pandemic-free situations, as government requirements for hand sanitization influence subjective preferences. Little research, however, has examined such associations in pandemic-neutral scenarios. To fill this gap, this study assesses the role of two aspects of time discounting—hyperbolic discounting and impatience—in influencing hand-sanitizing behavior in Japan. The study utilized two waves of 2021 and 2018 datasets derived from the Japanese population-based survey of the Preference Parameters Study of Osaka University (N = 725). The probit regression results provide partial support for deviation from hand sanitization as an impulsive decision because the phenomenon is evident only in females. There were no notable impacts of the impatience variable in any of the models or specifications. Our study provides important policy implications. We argue that one-size-fits-all policies may not solve the impulsivity associated with hand-sanitization behavior in Japan because the impulsivity problem is not commonly found among all respondents. Policymakers should consider underlying gender differences when designing future health-promoting measures.

Keywords: time discounting; impulsivity; impatience; hand-sanitizing behavior; Japan

Citation: Lal, S.; Nguyen, T.X.T.; Sulemana, A.-S.; Khan, M.S.R.; Kadoya, Y. Time Discounting and Hand-Sanitization Behavior: Evidence from Japan. *Sustainability* **2023**, *15*, 6488. https://doi.org/10.3390/su15086488

Academic Editor: Lotfi Aleya

Received: 15 March 2023
Revised: 3 April 2023
Accepted: 10 April 2023
Published: 11 April 2023

1. Introduction

Despite the role of hand washing and sanitizing in controlling the spread of viruses [1], non-compliance with hand sanitization remains a puzzle and major public health concern. Several studies conducted during the pandemic have argued that non-compliance with hand sanitizing is an impulsive decision, which could be explained by people's myopic time perspective [2,3]. However, this proposition is conditional on the government's requirements for hand sanitization; it may influence people's subjective judgement of hand sanitization. The impulsivity of not maintaining hand-sanitization requirements must be studied in a pandemic-free situation, where people practice hand sanitization for rational health benefit purposes. Few studies, however, exist on human hand-sanitization behavior in non-pandemic scenarios. Ong et al. [4] studied hand-washing tasks from the viewpoint of hyperbolic discounting (which refers to placing a disproportionately higher tendency on present than on future returns) before the pandemic in the USA and found that infrequent hand-washing behavior was positively and significantly associated with hyperbolic discounting. This finding suggests that deviation from hand-sanitizing procedures, even in pandemic-neutral scenarios, could be denoted as contextually impulsive. However, no such study has been conducted in Japan. This study fills this gap in the literature and provides evidence regarding how impulsivity and impatience are associated with hand-sanitization

behavior among the Japanese population. Conducting an impulsivity study of hand sanitization in Japan provides additional substantiation of the understanding and explanation of hand-sanitization behavior because hand sanitizing is considered a rational practice in Japan, not only for the perceived health benefits but also for maintaining long-standing social etiquette [5].

Many studies have used hyperbolic discounting as an instrument for comprehending people's impulsive behavior [6]. It refers to the situation in which a participant opts for a small immediate reward rather than a large later reward; this action consequently becomes pronounced as a maladaptive decision [7]. Hyperbolic discounting plays an important role in the decision-making process of individuals, in both monetary terms and in various behaviors related to health problems [8]. The practice of using hyperbolic discounting to analyze risky health behavior is not new in the literature [9]. For example, Bickel et al. [10] and Mitchell [11] found that monetary discounting rates are continuously higher in current smokers than in nonsmokers. Hyperbolic discounting also showed a consistent relationship with alcohol consumption behavior. Vuchinich and Simpson [12] found that higher discount rates were seen in "problem drinkers" and in heavy social drinkers compared with light social drinkers. Moreover, Ikeda [13] reported that hyperbolic discounters are more susceptible to experiencing high body weight. Regarding the behavior to seek health checkups, Fang and Wang [14] found that women suffering from a present bias were more likely to not undergo mammography tests.

Impulsivity or hyperbolic discounting could be linked to the trait-based nature of infrequent hand sanitizing in Japan, which is often conditional and inconsistent [15]. Sanitizing hands after outdoor activities or after doing any housekeeping/work-related activities protect a person from any form of underlying health threat, which will eventually improve their current and future health status [16,17]. However, the side effects related to the use of hand sanitizers, such as their continued use, could lead to dry, cracked skin as well as redness or discoloration, which might discourage people from frequently using such products [18]. Thus, for short-term convenience, a person could sacrifice his/her current long-term health. Similarly, people who infrequently sanitize their hands, who only see the present convenience and are not strategic thinkers, would choose small immediate rewards over large future rewards, which indicates an impulsive choice.

Given that impulsivity is linked to several irrational health behaviors [12–14] and that Japanese people's hand-sanitization practices are often conditional and inconsistent [15], we used two aspects of time discounting, impatience and impulsivity, to explain hand-sanitizing behavior in Japan in a pandemic-neutral scenario. First, the impatience variable is formulated by discount rates, and higher discount rates mean a higher degree of impatience, which would result in more infrequent hand-sanitizing behavior. Thus, we hypothesize that higher discounters tend not to sanitize their hands as frequently than others. Second, hyperbolic discounting can be explained from the impulsivity perspective, wherein hyperbolic individuals make present-biased intertemporal choices. Therefore, in this study we hypothesize that by making time-inconsistent choices, hyperbolic discounters are likely to not sanitize hands after performing any household/work-related activities or after being in public spaces.

This study contributes to the literature in at least three ways. First, to the best of our knowledge, this is the first study in Japan to attempt to establish a relationship between time discounting and hand-sanitizing behavior outside the circumstance of any major outbreak. Second, this study captures how the decision to frequently sanitize hands reflects the rational health perspective of people in Japan following numerous previous outbreaks. Third, this study performed a subsample analysis using a broader age group and gender analysis to deeply understand impatience and impulsivity among various age- and gender-based groups.

2. Data and Methods

2.1. Data

Data were collected from the preference parameter study (PPS) conducted by the Institute of Social and Economic Research at Osaka University. The survey was part of the Japan household panel survey on consumer preferences and satisfaction (JHPS-CPS). The PPS is a yearly panel survey of waves from 2003 to 2013, 2016–2018, and 2021–2022. Details regarding the survey and the dataset are available at: https://www.iser.osaka-u.ac.jp/survey_data/top_eng.html (Accessed on 1 April 2023). The survey applied a 2-stage stratified random sampling technique for the data: first, Japan's prefectures were divided into 10 regional blocks of Hokkaido, Tohoku, Kanto, Koshinetsu, Hokuriku, Tokai, Kinki, Chugoku, Shikoku, and Kyushu. Second, each region was subdivided into 4 strata according to the size of the municipality: government-designated major cities, cities with populations of more than 100,000, cities with populations of less than 100,000, and towns and villages. The 2018 wave was used to obtain data on time discounting and all other relevant control variables, whereas the 2021 dataset was only used to extract data on hand-sanitizing behavior before the pandemic in 2020. Data on hand sanitization included in the 2021 dataset were collected in 2020 when the COVID-19 situation was not declared a pandemic. After merging the 2 datasets and dropping any unmatched/missing data, the sample size reached 725 observations, representing 53.94% of the valid respondents in the 2018 dataset (which had 1344 observations). We checked the distribution of data before and after dropping observations with missing values but did not observe a major difference in distribution that could materially affect the results of the study. Thus, the final data of this study seem to be sufficient and representative to provide an unbiased result.

2.2. Variables

Our dependent variable, "hand sanitizing behavior", is based on the 2021 questionnaire, within which a statement with a Likert scale was dedicated to inquiring about health safety measures, such as hand sanitizing, in the first half of January (1–15 January 2020) before COVID-19. The statement was, "I frequently wash and sanitize my hands", with choices on an increasing scale of 1 to 5, from "doesn't apply at all" to "applies exactly". As we hypothesized that impatience and hyperbolic discounting make people less likely to wash and sanitize hands, we categorized these answers into binary variables. Specifically, we grouped the responses of 4 and 5 as frequent hand sanitizers, coded as 1, and those who answered between 1 and 3 as infrequent hand sanitizers, coded as 0.

Our main explanatory variables were impatience and hyperbolic discounting. The degree of impatience was measured by combining responses to the 2 intertemporal questions. We treat impatience as a continuous variable by averaging the standardized values of the elicited discount rates of DR1 (discount rate 1) and DR2 (discount rate 2) from the 2 monetary choice questions, as shown in Appendix A. Another time discounting factor included in our study is hyperbolic discounting, a binary variable that equals 1 if DR1 > DR2, and 0 otherwise.

Furthermore, to estimate the association between hand-sanitizing behavior and each of the 2 time-discounting aspects, we controlled for demographic and socioeconomic effects, such as gender, age, marital status, employment situation, living status, number of household members, having children, and household finances; behavioral effects, such as financial satisfaction, risk preference, and health anxiety; and risky health behaviors, such as smoking, alcohol consumption, and gambling. A detailed description of all variables is provided in Table 1.

Table 1. The definition of variables.

Variables	Definitions
Hand-Sanitizing Behavior *	Binary variable which equals 1 = if when the respondent completely agrees or agrees with the statement "I frequently wash and sanitize my hands", and 0 otherwise.
Impatience	Continuous variable: simple mean of the standardized values of the elicited discount rates (DR1 to DR2).
Hyperbolic Discounting	Binary variable which equals 1 if DR1 > DR2 and, 0 otherwise.
Male	Binary variable: 1 = male, 0 = female.
Age	Age of participants.
Marriage	Binary variable: 1 = currently married, 0 = otherwise.
Divorce	Binary variable: 1 = divorced, 0 = otherwise.
Full-Time Employment	Binary variable: 1 = employed full time, 0 = otherwise.
Living Alone	Binary variable: 1 = living alone, 0 = otherwise.
Household Size	The number of people living in the household.
Children	Binary variable: 1 = have at least 1 child, 0 = otherwise.
Log of Household Income	Log of annual earned income, before taxes and with bonuses, of the entire household in 2017 (unit: million JPY).
Log of Household Assets	Log of balanced amount of financial assets (savings, stocks, insurance, etc.) of entire household (unit: million JPY).
Financial Satisfaction	Binary variable that equals 1 if the respondent is very satisfied or satisfied with the current financial situation of their household, and 0 otherwise.
Risk Rain Preference	Continuous variable: percentage score from the question "Usually when you go out, how high must the probability of rainfall be before you take an umbrella?".
Health Anxiety	Binary variable that equals 1 if the respondent has very strong or strong feelings of health anxiety, and 0 otherwise.
Smoking	Binary variable: 1 = smoke (occasionally, more than one pack a day), 0 = do not smoke (never smoke, hardly smoke, already quit smoking).
Alcohol Drinking	Binary variable: 1 = drink (sometimes, 5 cans a day), 0 = do not drink (do not drink at all, hardly drink).
Gambling	Binary variable: 1 = frequent gambler (gamble at least once a week or more) and 0 = otherwise.

Note: The symbol * indicates data from the 2021 dataset, otherwise 2018.

2.3. Descriptive Statistics

The descriptive statistics of the elicited discount rates, together with the choice conditions under which they are elicited, are summarized in Table 2, where DR1 and DR2 represent the estimated discount rates. The sample mean impatience level was 0.0065. Moreover, as there is a significant offset between DR1 and DR2 at the 1% significance level, hyperbolic discounting is therefore prominent in the overall sample and its effects are observed on average.

Table 3 shows the descriptive statistics of the dependent variables and the other control variables. Interestingly, more than 49% of respondents frequently sanitized their hands, indicating that hand-sanitizing practices have normalized in Japan. Moreover, 44.6% of the observations were from men, and the average respondent's age was 59 years. Results also show that 83.4% of the respondents were married and 3.4% of the respondents were divorced. Approximately one-third of the sample worked full time. Additionally, nearly 6% of the respondents lived alone. The average number of household members was 3

and 87.8% had children. The average household had an annual income equivalent to 6.22 million yen and held assets worth 17.8 million yen. Almost 34% were satisfied with their financial situation, whereas approximately 45.8% were anxious about their health conditions. The average respondent rated the risk preference as 0.46. For risky health behaviors, nearly 31% of the respondents gambled frequently, whereas the percentages of those who smoked and drank alcohol were 14.2% and 42.2%, respectively.

Table 2. Elicited discount rates under alternative choice conditions.

		DR1	**DR2**	**Impatience**
Choice conditions	Timings (A) or (B)	Today or 7 days	90 days or 97 days	-
	Receipt or payment	Receipt	Receipt	-
Descriptive statistics	Mean	2.4329	0.7637	0.0065
	S.D.	6.8354	2.3828	0.8006
	Observations	725	725	725
Time discounting properties (*p*-value)		Hyperbolic discounting: DR1 > DR2 (0.000)		

Table 3. Descriptive statistics of the dependent variable and other control variables.

	Mean	**Std. Dev.**	**Min**	**Max**
Dependent Variable				
Hand-Sanitizing Behavior	0.4952	0.5003	0	1
Control Variables				
Male	0.4455	0.4974	0	1
Age	58.9959	11.7818	30	85
Marriage	0.8345	0.3719	0	1
Divorce	0.0345	0.1826	0	1
Full-Time Employment	0.3476	0.4765	0	1
Living Alone	0.0621	0.2414	0	1
Household Size	3.1903	1.3775	1	8
Children	0.8786	0.3268	0	1
Household income	6.2241	3.8292	1	20
Log of Household Income	1.6428	0.6304	0	2.9957
Household assets	17.8052	20.7443	2.5	100
Log of Household Asset	2.2955	1.0857	0.9163	4.6052
Financial Satisfaction	0.3393	0.4738	0	1
Rain Risk Preference	0.4636	0.1958	0	1
Health Anxiety	0.4593	0.4987	0	1
Smoking	0.1421	0.3494	0	1
Alcohol Consumption	0.4221	0.4942	0	1
Gambling	0.3062	0.4612	0	1
Observations		725		

According to the summarized distribution of hand-sanitizing behavior by time-discounting characteristics in Table 4, just over half of the respondents were impatient based on the elicited discounted rates. There was no significant difference in the levels of impatience between the frequent and infrequent hand sanitizers. In addition, we observed a heterogeneous hand-sanitizing tendency using a hyperbolic discounting factor. A higher proportion of infrequent hand sanitizers were hyperbolic discounters (57.26%) than frequent hand sanitizers (42.74%).

Table 4. Distribution of hand-sanitizing behavior by time discounting characteristics.

Hand-Sanitizing Behavior	Impatience	Hyperbolic Discounting	
		0	**1**
0	366 50.48%	228 47.11%	138 57.26%
1	359 49.52%	256 52.89%	103 42.74%
Total	725 100%	484 100%	241 100%
Mean difference	t-value = 0.4835	t-value = 2.5843 ***	

Note: *** indicates $p < 0.01$.

2.4. Methodology

As components of time discounting, such as hyperbolic discounting and impatience, have been widely viewed as instruments pertinent in comprehending people's maladaptive decisions, we apply the same concept to infrequent hand-sanitizing behavior in Japan. We hypothesized that infrequent hand sanitizers are likely to show irrational and impulsive behavior and exhibit higher discount rates than frequent hand sanitizers. Linking this to a financial behavioral perspective, if an individual lacks perseverance, he/she would choose an immediate award and subjectively discount the value of the larger, future reward [19]. In technical terms, an outcome that has utility A if received immediately ($t = 0$) is valued at $A.\delta^t$ if it is timed t periods into the future. Thus, the present-time value (V) of receiving (A) at time (t) is given by:

$$V(A,t) = A.\delta^t \quad (1)$$

The discount rate δ represents the fixed proportional decrease in the value for each added period. However, humans are known to violate the exponential assumption of a constant proportional discount factor per unit of time, and discount rewards appear in the immediate future more sharply than in the distant future [20]. Thus, a hyperbolic function provides a good representation of the discount function estimated from these observed choices and acts as an interpreted description of time discounting.

$$V(A,t) = A.\frac{1}{1+k.t} \quad (2)$$

where k represents the hyperbolic discount rate.

After specifying the hyperbolic function to capture the irrationality behind infrequent hand-sanitizing behavior, we performed a probit regression to test our hypothesis as our dependent variable was binary. Equation (3) assesses the combined effects of the main independent variables (impatience and hyperbolic discounting) with hand-sanitizing behavior in Japan.

$$Y_i = f(IP_i, HD_i, X_i, \varepsilon_i) \quad (3)$$

where Y_i represents the hand-sanitizing behavior of the ith respondent; IP and HD represent the impatience and hyperbolic discounting variables, respectively; X is a vector of respondents' demographic and socioeconomic characteristics; and ε is the error term, which follows the white noise process.

To avoid any potential intercorrelation issues among the independent variables, we conducted association and multicollinearity tests for all models (results available upon request). Our findings showed a weak association between the explanatory variables (<0.7) and no multicollinearity in all the models (variance inflation factor < 3).

We created 5 models for Equation (3), each with a distinct control variable. Equations (4)–(8) represent Models 1.1, 1.2, 1.3, 1.4, and 1.5, respectively.

$$Hand\ sanitizing\ behavior_i = \beta_0 + \beta_1 impatience_i + \beta_2 hyperbolic\ discounting_i + \varepsilon_i \quad (4)$$

$$\begin{gathered} Hand\ sanitizing\ behavior_i = \beta_0 + \beta_1 impatience_i + \beta_2 hyperbolic\ discounting_i + \\ \beta_3 male_i + \beta_4 age_i + \beta_5 marriage_i + \beta_6 divorce_i + \beta_7 full - time\ employment_i + \\ \beta_8 living\ alone_i + \beta_9 household\ size_i + \beta_{10} children_i + \varepsilon_i \end{gathered} \quad (5)$$

$$\begin{gathered} Hand\ sanitizing\ behavior_i = \beta_0 + \beta_1 impatience_i + \beta_2 hyperbolic\ discounting_i + \\ \beta_3 male_i + \beta_4 age_i + \beta_5 marriage_i + \beta_6 divorce_i + \beta_7 full - time\ employment_i + \\ \beta_8 living\ alone_i + \beta_9 household\ size_i + \beta_{10} children_i + \beta_{11} \log\ of\ household\ income_i \\ + \beta_{12} \log\ of\ household\ asset_i + \beta_{13} financial\ satisfaction_i + \varepsilon_i \end{gathered} \quad (6)$$

$$\begin{gathered} Hand\ sanitizing\ behavior_i = \beta_0 + \beta_1 impatience_i + \beta_2 hyperbolic\ discounting_i + \\ \beta_3 male_i + \beta_4 age_i + \beta_5 marriage_i + \beta_6 divorce_i + \beta_7 full - time\ employment_i + \\ \beta_8 living\ alone_i + \beta_9 household\ size_i + \beta_{10} children_i + \beta_{11} \log\ of\ household\ income_i \\ + \beta_{12} \log\ of\ household\ asset_i + \beta_{13} financial\ satisfaction_i + \beta_{14} risk\ rain\ preference_i \\ + \beta_{15} health\ anxiety_i + \varepsilon_i \end{gathered} \quad (7)$$

$$\begin{gathered} Hand\ sanitizing\ behavior_i = \beta_0 + \beta_1 impatience_i + \beta_2 hyperbolic\ discounting_i + \\ \beta_3 male_i + \beta_4 age_i + \beta_5 marriage_i + \beta_6 divorce_i + \beta_7 full - time\ employment_i + \\ \beta_8 living\ alone_i + \beta_9 household\ size_i + \beta_{10} children_i + \beta_{11} \log\ of\ household\ income_i \\ + \beta_{12} \log\ of\ household\ asset_i + \beta_{13} financial\ satisfaction_i + \beta_{14} risk\ rain\ preference_i \\ + \beta_{15} health\ anxiety_i + \beta_{16} smoking_i + \beta_{17} alcohol\ drinking_i + \beta_{18} gambling_i + \varepsilon_i \end{gathered} \quad (8)$$

3. Results

The probit regression results provide evidence of the association between hand-sanitizing behavior and the two aspects of time discounting, as shown in Table 5. The first specification (Model 1.1) includes the two main time-discounting variables, whereas the second specification (Model 1.2) includes the respondents' demographic characteristics. The third specification (Model 1.3) adds the household's financial aspects, such as income, assets, and the degree of financial satisfaction. The fourth specification (Model 1.4) includes psychological features, such as risk preference and health anxiety. Finally, risky health behaviors such as smoking, drinking, and gambling were added to the fifth model (Model 1.5).

The results in Table 5 show that the impatience variable has an insignificant association with hand-sanitizing behavior, whereas hyperbolic discounting shows a significantly negative association with hand-sanitizing behavior across all models at a 5% significance level. In addition, most demographic and other control variables indicate consistent effects across the models in terms of signs and significance levels. Male gender, marriage, log of household income, and log of household assets had negative and significant effects on hand-sanitizing behavior. However, financial satisfaction was positively associated with hand-sanitizing behavior at the 1% significance level.

The categorization of various socioeconomic and demographic characteristics by age and gender revealed significant findings regarding hand-sanitizing behavior, as shown in Table 6. We observed that hyperbolic discounting is negatively and significantly associated with hand-sanitizing behavior, but only for females of both younger and older age groups. Moreover, the important variables that were not previously significant in the full-sample analysis became significant in the subsample analysis. Specifically, we observed that age is positively associated with hand-sanitizing behavior, but only among females aged 65 years and over. Interestingly, older females who live alone and have a larger household size show a positive association with hand-sanitizing behavior. Compared with their counterparts, only men over the age of 65 years who have at least one child are favorably associated with hand-sanitizing behavior. Moreover, younger females with health anxiety tended to comply more with hand-sanitizing practices. In addition, younger males and females who consume alcohol or engage in pathological gambling, respectively, exhibit a negative association with hand-sanitizing behavior. Apart from the log of household income, variables such as the log

of household assets and financial satisfaction continue to be significant under the subsample analysis, with the exception that their significance level varies by age and gender.

Table 5. Probit regression results of hand-sanitizing behavior with two main explanatory variables.

Variables	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5
Impatience	0.0168 (0.0606)	0.0275 (0.0612)	0.0165 (0.0622)	0.0122 (0.0617)	0.0116 (0.0619)
Hyperbolic discounting	−0.264 ** (0.104)	−0.248 ** (0.106)	−0.231 ** (0.106)	−0.228 ** (0.107)	−0.223 ** (0.107)
Male		−0.321 *** (0.105)	−0.336 *** (0.106)	−0.327 *** (0.107)	−0.312 *** (0.113)
Age		0.00177 (0.00516)	0.00195 (0.00556)	0.00120 (0.00560)	0.00160 (0.00561)
Marriage		−0.347 * (0.193)	−0.315 (0.194)	−0.332 * (0.194)	−0.311 (0.196)
Divorce		0.158 (0.322)	0.154 (0.324)	0.154 (0.322)	0.159 (0.325)
Full-Time Employment		−0.0543 (0.116)	−0.0312 (0.121)	−0.0261 (0.121)	−0.0172 (0.121)
Living Alone		−0.0919 (0.242)	−0.123 (0.246)	−0.143 (0.247)	−0.126 (0.248)
Household Size		0.0267 (0.0431)	0.0503 (0.0444)	0.0529 (0.0444)	0.0560 (0.0443)
Children		0.252 (0.189)	0.213 (0.191)	0.212 (0.192)	0.220 (0.192)
Log of Household Income			−0.155 * (0.0910)	−0.157 * (0.0913)	−0.160 * (0.0913)
Log of Household Asset			−0.110 ** (0.0511)	−0.110 ** (0.0513)	−0.116 ** (0.0514)
Financial Satisfaction			0.331 *** (0.113)	0.334 *** (0.114)	0.340 *** (0.114)
Risk Rain Preference				−0.295 (0.249)	−0.284 (0.248)
Health Anxiety				0.0792 (0.0957)	0.0860 (0.0962)
Smoking					0.0977 (0.144)
Alcohol Drinking					−0.0460 (0.104)
Gambling					−0.113 (0.108)
Constant	0.0752 (0.0578)	0.111 (0.376)	0.423 (0.402)	0.573 (0.431)	0.549 (0.434)
Observations	725	725	725	725	725
Log Likelihood	−499.1	−487.3	−480.9	−479.9	−479
Chi^2 Statistics	6.685	28.73	40.01	41.83	43.29
p-value	0.0353	0.00138	0.000138	0.000239	0.000729

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6. Probit regression results of hand-sanitizing behavior with two main explanatory variables, by gender and two main age groups.

Variables	Male		Female	
	Younger Subsample (<65)	**Older Subsample (≥65)**	**Younger Subsample (<65)**	**Older Subsample (≥65)**
Impatience	0.0418 (0.1267)	−0.3088 (0.2070)	−0.0093 (0.0870)	−0.0439 (0.1280)
Hyperbolic Discounting	−0.0975 (0.2235)	0.1194 (0.2689)	−0.3952 ** (0.1763)	−0.5442 * (0.2951)
Age	−0.0210 (0.0153)	0.0130 (0.0291)	0.0047 (0.0124)	0.0618 ** (0.0272)
Marriage	−0.1781 (0.4517)	0.7148 (0.6560)	−0.3633 (0.3473)	−0.1480 (0.4559)
Divorce	-	-	0.1596 (0.4533)	−0.7035 (0.8313)
Full-Time Employment	−0.2053 (0.2702)	0.1632 (0.3681)	0.0268 (0.1934)	−0.8719 (0.5741)
Living Alone	−0.0584 (0.6050)	-	−0.4440 (0.4154)	1.1318 * (0.6138)
Household Size	0.0521 (0.0937)	0.0217 (0.0974)	0.0505 (0.0805)	0.3033 ** (0.1363)
Children	0.1702 (0.3732)	1.1280 * (0.6332)	0.0341 (0.3637)	0.0095 (0.5770)
Log of Household Income	0.1078 (0.2054)	−0.1188 (0.2247)	−0.1693 (0.1519)	−0.3264 (0.2648)
Log of Household Asset	0.1041 (0.1091)	−0.2962 ** (0.1175)	−0.2342 ** (0.0955)	0.1308 (0.1386)
Financial Satisfaction	−0.0864 (0.2409)	0.4464 * (0.2657)	0.6541 *** (0.2077)	0.4214 (0.2902)
Risk Rain Preference	−0.3417 (0.4858)	0.2043 (0.6196)	−0.3615 (0.4397)	−0.0332 (0.7200)
Health Anxiety	−0.0138 (0.1999)	−0.2163 (0.2483)	0.5511 *** (0.1648)	−0.2771 (0.2591)
Smoking	0.0574 (0.2146)	0.0513 (0.3481)	0.1109 (0.3144)	0.5826 (0.6284)
Alcohol Consumption	−0.4176 ** (0.2113)	−0.0392 (0.2442)	0.3838 ** (0.1773)	−0.1852 (0.3318)
Gambling	0.1791 (0.2053)	0.1416 (0.2615)	−0.4081 ** (0.1875)	−0.2025 (0.3124)
Constant	0.6919 (0.9248)	−2.0861 (2.4629)	0.6521 (0.7739)	−4.7886 ** (2.2479)
Observations	191	125	273	129
Log Likelihood	−120.2	−77.21	−166.4	−74.80
Chi^2 Statistics	10.50	18.20	38.37	23.15
p-value	0.839	0.252	0.00219	0.145

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4. Discussion

We investigated hand-sanitizing behavior among the Japanese population from the viewpoint of impatience and impulsivity in a pandemic-neutral scenario. Our results showed that impatience was not related to hand-sanitizing behavior. Thus, our results do not support previous findings on the impact of impatience on other health-damaging behaviors, such as tobacco use, alcohol consumption, and gambling [21]. For hyperbolic discounting, our results are consistent with existing studies conducted before the pandemic, in which participants who showed steeper time discounting in the monetary discounting task also tended to discount steeply in the handwashing task [4]. Moreover, several other studies conducted during the COVID-19 pandemic, such as Soofi, Najafi, and Karami-Matin [2] and Camargo et al. [3], have indicated that individuals with present-biases (myopic view) are less likely to adhere to COVID-19 preventative behaviors, such as staying at home and hand washing. However, the effects of hyperbolic discounting on hand-sanitization behavior differ considerably by gender and age group, of which only females of both younger and older age groups are influenced by this time-discounting facet. Although no studies currently exist that performed a sub-sample analysis of hand-sanitization behavior by gender and broader age group, a study by Ong, Graves, and Berry [4] found that female gender was associated with greater time discounting (higher impulsivity) in hand-washing procedures.

For demographic variables, we found that males were less likely to engage in frequent handwashing behavior than their female counterparts. This finding is consistent with those of many other studies conducted before the pandemic [22,23]. Furthermore, the age variable only appeared significant among respondents who were female and of the older age group, which showed more frequent hand-sanitizing behavior. This finding is consistent with previous studies, such as Haston et al. [24], who found that a higher percentage of older women in the USA reported washing their hands in multiple situations than men.

Among the sociological variables, we found that the association between marriage and hand-sanitizing behavior was insignificant and erratic across models. This inconsistency is supported by previous studies, in which Natnael et al. [25] suggested that marital status was not significantly related to hand hygiene practices, whereas Yang, et al. [26] provided contradictory results. Moreover, older females who were living alone were more likely to frequently sanitize their hands. According to Czaja et al. [27], owing to changes in living circumstances, an elderly Japanese woman would engage in better lifestyle and health promotion initiatives, such as washing and sanitizing hands [28].

Household size and having children are favorably associated with hand hygiene practices, with the effects being marginally significant among elderly people of both genders. Our results imply that people aged 65 or over who were living in a household with more family members and children complied most with hand-sanitizing behavior. We argue that older populations are one of the most vulnerable groups for infectious disease prevention. Thus, complying with hand hygiene practices is usually reported to be stricter in this age group compared with the younger population [25,26].

The results on household wealth structure revealed that older males and younger females with higher assets are less likely to practice hand sanitizing, which is inconsistent with several findings [29–31]. A possible reason is that rich individuals are more likely to develop pandemic fatigue and experience a decline in preventative measures such as hand sanitization [32]. In addition, financially satisfied respondents were more likely to practice hand sanitization, which is consistent with previous studies [33]. In particular, financially satisfied older males and younger females practiced frequent hand sanitizing more than other groups, which is consistent with the findings of [34].

Among psychological and risky health behavior elements, health anxiety is favorably associated with hand-sanitizing behavior, but only among younger females. Research has shown that men are less cooperative than females in terms of public health behavior and are less likely to take care of their health and undergo regular testing and screening [34].

Furthermore, younger males who engaged in alcohol consumption behavior were less likely to practice hand disinfection. However, the opposite effect was observed in younger females. Traditional gender standards and perceived risk vulnerability may explain these gender group trends, as males are sometimes seen as bigger risk-takers than their female counterparts. Finally, we found that among the participants, largely younger female gamblers deviated from handwashing behavior. This is supported by the notion that gambling acts as a paradigm for the irrationality of human choice behavior in risk-taking and decision-making processes [35].

Several limitations of this study should be considered when interpreting these findings. First, there could be a subjectivity issue in the definition of the main dependent variable of "frequent hand sanitizing" (could be interpreted differently by different respondents), which is a common limitation in these kinds of studies. Second, our study had a relatively small sample size; thus, to make sufficient inferences of the current findings to the broader population in Japan, a more comprehensive study with a larger dataset is needed. Third, the discount rates in this study were produced from two hypothetical questions on intertemporal monetary choices. As such, there is a chance that the results obtained here cannot be applied to real-life situations because they do not precisely show an individual's reactions to an anxiety-provoking situation.

5. Conclusions

This study investigated the relationship between handwashing behavior and two aspects of time discounting: impatience and hyperbolic discounting. We hypothesized that impatience and hyperbolic discounting would be negatively associated with frequent hand sanitization. The results of the probit regression showed that people who were hyperbolic discounters were more likely to deviate from frequent hand-sanitization behavior, which seems to be more pronounced among females of both younger and older age, compared to their counterparts. However, there were no notable impacts of the impatience variable on any of the models and specifications. The signs and significance levels of all other control variables vary across genders and broader age groups.

Our findings help establish a significant relationship between hyperbolic discounting and hand-sanitizing behavior outside of the circumstances of any major outbreak in Japan. As the country had experienced several outbreaks, we could justify our position based on why non-compliance with frequent hand sanitization in a pandemic-neutral scenario could be treated as impulsive behavior. This was achieved by linking people's behavioral responses with a rational health perspective and increased health anxiety. As this study revealed that impulsive people were less likely to engage in frequent hand-sanitizing behavior, we believe that one-size-fits-all policies may not solve the non-hand-sanitization issue outside the pandemic context. Special programs should be directed towards people showing impulsivity towards hand-sanitizing behavior, such as older males and younger females, even when the pandemic situation eases. Therefore, it is recommended that future time-preference research should focus on subsamples of gender and age to gain a more thorough insight into discounting properties among this group and how these factors affect their hand-sanitization behavior within the pandemic-neutral setting.

Author Contributions: Conceptualization, Y.K.; methodology, S.L., T.X.T.N., A.-S.S., Y.K. and M.S.R.K.; formal analysis, S.L., T.X.T.N., A.-S.S., M.S.R.K. and Y.K.; writing—original draft, T.X.T.N., A.-S.S. and S.L.; writing—review and editing, M.S.R.K. and Y.K.; investigation, T.X.T.N., S.L., and A.-S.S.; data curation, T.X.T.N., S.L., and A.-S.S.; software, T.X.T.N. and S.L.; supervision, Y.K.; project administration, M.S.R.K. and Y.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by JSPS KAKENHI, grant numbers JP19K13739, JP19K13684, JP23H00837, and JP23K12503.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data are available upon request.

Acknowledgments: This research utilized microdata from the Preference Parameters Study of Osaka University's 21st Century COE Program "Behavioral Macro-Dynamics Based on Surveys and Experiments", its Global COE project "Human Behavior and Socioeconomic Dynamics", and JSPS KAKENHI 15H05728 "Behavioral-Economic Analysis of Long-Run Stagnation". The authors acknowledge the contributors to the program/projects: Yoshiro Tsutsui, Fumio Ohtake, and Shinsuke Ikeda.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Question A3. Suppose you receive money from someone. You can either choose to receive the money today or seven days from today, but the amounts will be different. Compare the amounts and dates below in Option "A" and Option "B", and indicate which option you prefer for each of the nine choices.

Option A—Receiving Today	Option B—Receiving in 7 Days from Today	Circle A or B	
JPY 3005	JPY 3014	A	B
JPY 3003	JPY 3297	A	B
JPY 3008	JPY 3037	A	B
JPY 3000	JPY 3000	A	B
JPY 3005	JPY 5951	A	B
JPY 3009	JPY 3068	A	B
JPY 3001	JPY 3119	A	B
JPY 3002	JPY 2996	A	B
JPY 3008	JPY 3011	A	B

Question A4. Now, suppose that you are to receive money from someone, and you can choose either to receive the money 90 days from today or 97 days from today, but the amounts will be different. Compare the amounts and dates below in Option "A" and Option "B" and indicate which option you prefer for each of the nine choices.

Option A—Receiving in 90 Days from Today	Option B—Receiving in 97 Days from Today	Circle A or B	
JPY 3000	JPY 3118	A	B
JPY 3006	JPY 3000	A	B
JPY 3000	JPY 3009	A	B
JPY 3007	JPY 3301	A	B
JPY 3006	JPY 3035	A	B
JPY 3002	JPY 3005	A	B
JPY 3007	JPY 5955	A	B
JPY 3001	JPY 3001	A	B
JPY 3007	JPY 3066	A	B

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