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Full Length Research Paper

The impact of background music and sound in decision making: A case study in experimental economics laboratory

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This paper experimentally studies the impact of background music and sound on the preference of the decision makers (DMs) for rewards in pairwise intertemporal choice tasks and lottery choice tasks. The participants took part in the current experiment, involving four treatments: (1) familiar music, (2) unfamiliar music, (3) noise and (4) no music. The experimental results confirm that background noise influences human performance in decision making under risk and intertemporal decision making, though the results do not indicate the existence of the significant familiarity effect.

Key words: Allais-type preferences, choice under risk, intertemporal choice, the familiarity effect.

INTRODUCTION

This paper shall experimentally investigate the relation between the background music/sound and behavioural preference (that is, risk and time preference). For investigating risk preference, this paper elicits decision-making preferences in “choice under risk” (referred to as Type A decisions in this paper), that is, choices under the followings: (1) “low-and high-money payoffs” (for example, a choice between a 80% chance of winning 400 yen and sure 300 yen; or a choice between a 80% chance of winning 4000 yen and sure 3000 yen) and; (2) “low-and high-probability payoffs” (for example, a choice between a 80% chance of winning 4000 yen and sure 3000 yen; or a choice between a 20% chance of winning 4000 yen and a 25% chance of winning 3000 yen). On the other hand, for investigating time preference, this paper elicits decision-making preferences in “intertemporal choice” (referred to as Type B decisions), that is, choices under the followings: (1) “smaller–sooner/later payoffs” (for example, a choice between 800 yen in 7 days and 880 yen in 30 days; or a choice between 500 yen in 7 days and 550 yen in 30 days), (2) “larger–sooner/later payoffs” (for example, a choice between present 5000 yen and 5500 yen in 30 days; or a choice between present 5000 yen and 5005 yen in 7 days) and (3) “larger–sooner/smaller-later payoffs” (for example, a choice between 800 yen in 7 days and 1600 yen in 14 days; or a choice between 900 yen in 7 days and 1800 in 14 days). The current paper also elicits decision-making preferences in “self-evident choice” (referred to as Type C decisions), that is, choices under the followings: (1) “lower risk and higher payoffs” (for example, a choice between 70% chance of winning 200 yen and 50% chance of winning 100 yen), (2) “sooner and higher payoffs” (for example, a choice between present 200 yen and 100 yen in 7 days).

The goal of the present study is to see if familiar and unfamiliar background music and noise sound could influence the behaviour of the participants, who were asked to make decisions in choice under risk and intertemporal choices. The current experiment was conducted to examine the impact of the background music and sound presented to the participants during their choice tasks, involving choice under uncertainty and intertemporal choice. We used three forms of background

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Abbreviations: DMs, Decision makers; **KEEL,** Kyoto Experimental Economics Laboratory; **bpm,** beats per minute.

music and sound (that is, familiar music, unfamiliar music and noise).

Before this paper continues, an effort is taken here to provide an outline of decision making. Decision making, in the end, is to make a choice or judgment about something and the process of identifying and choosing alternative courses of action in a manner appropriate to the demand of the situation (Fullan, 1982). The topic of decision making is prevalent among many disciplines. One example is concerned with the head in an organisation: She/he may think about an issue, revises it, makes her/his decision and announces it (Hashim, 2010). This example is known as a one-person rule in the field of management (Carmeli, 2008). This paper presents a series of one-person economics decision making problems that require scrutiny.

The first research objective is to demonstrate to what extent the decision makers (DMs') behaviour is influenced by various background music and sound. The research objective is to explore the question: Do familiar and unfamiliar background music and the white noise sound affect influence human behaviour? Do the DMs change their behaviour in the presence of these background music and sound?

The second research objective is to demonstrate to what extent the DMs' performance and preference in economic decision making are influenced by various background music and sound. This second research objective is to explore the question: Do the DMs' performance and preference influence their behaviour when they make decisions in the presence of familiar background music and the white noise sound? Do the difference of the sound type and structure affect to their performance or preference?

The third research objective is to demonstrate to what extent the DMs exhibit the familiarity effect when they engage in economic decision making. This third research question is to explore the question: Do the DMs behave exhibiting the increased or attenuated familiarity effect in the presence of familiar background music? Does familiar background music facilitate or detract the familiarity effect when they engage in decision making?

Do familiar and unfamiliar background music and the white noise sound affect human behaviour? Do the decision makers (DMs) change their behaviour in the presence of these background music and sound?

Do the DMs' performance and preference affect their behaviour when they make decisions in the presence of familiar background music and the white noise sound? Do the difference of the sound type and structure affect to their performance or preference?

Do the DMs behave exhibiting the increased or attenuated familiarity effect in the presence of familiar background music? Does familiar background music facilitate or detract the familiarity effect when they engage in decision making?

IMPACT OF BACKGROUND MUSIC IN DECISION MAKING

Music is the most specialised, peculiar human cultural artifact (Andrade, 2004; Beament, 2001) and powerful stimulus to our behaviour and decision making. One raises a question: Can background music affect influence our behaviour? There has been much of the controversy pertaining to this question (Brayfield and Crockett, 1955; Jacob, 1968; McGehee and Gardner, 1949; Milliman, 1982; Smith, 1947; Uhrbrock, 1961). Hilliard and Tolin. (1979) showed that performance in the presence of familiar background music is higher than that in the presence of unfamiliar music. Music is employed in the background of offices and retail stores to produce certain desired behaviours and decision making among employees and/or customers (Milliman, 1982). Bruner (1990) presumed that music affects human being in various ways as long as people have played music. Having accepted this presumption, previous researchers presented study on the behavioural influences on music in decision making.

There exists literature pertinent to the influences of music on behaviour and decision making. Iwanaga and Itoet al. (2002) examined the disturbance influence of music on human behaviour in memory tasks. They conducted an experiment in which the participants performed choice tasks in the presence of vocal music, instrumental music, a natural sound and no music. We here note that vocal music contains more verbal information than instrumental music (Iwanaga and Ito, 2002). Iwanaga et al.and Ito (2002) reported that highest disturbance was observed under the vocal music condition. Sundstrom and Sundstromet al. (1986) showed that music was effective in maintaining both arousal and motivation when the DMs were performing easy decision-making tasks. Wolf and Weiner (1972) asked undergraduates to perform a mental arithmetic task with having them listen to rock music, and showed that their performance in the task was neither decreased nor increased. Hence, the influence s of background music in decision making are is inconsistent. The kinds of background music varied: classical (Hilliard and Tolin, 1979), folk (Mowsesian and Heyer, 1973), hardrock (Wolf and Weiner, 1972), vocal and instrumental (Salamé and Baddeley, 1982.), pop (Iwanaga and Ito, 2002). All of background music in these studies consisted of existing songs (for example, Mozart, well-known Japanese pop songs, and so on).

The familiarity effect

In previous experiments, the "familiarity effect" was likely to be idiosyncratic among individual participants. The familiarity effect is a change of preference in the presence of familiar background music/sound. Previous authors

authors conducted experiments in which the participants were asked to perform the tasks in the presence of background music that was chosen either biasedly or unbiasedly from the list of existing songs (Mozart in Rauscher, Shaw et al., 1993).

Thus, the previous experiments were conducted with the setting where the songs used as background music had been available. This setting leads to difficulties with experimental controls, in such a way that impression towards particular songs was idiosyncratic among the participants. For example, imagine two participants: one, who is very familiar to the music played during the experiments and another, who has never listened to it, thus it is her first time to listen to it. The former participant would have less cognitive (or perceptive) emotions which change their performance and preference, such as curiosity and surprise about the music, thus not pay much attention to the music because she knows the music well. On the other hand, the latter participant would have more cognitive (or perceptive) emotions which change their performance and preference, as she has neither background knowledge nor personal image about the music.

Thus, she would pay much attention to the music and make an effort to acquire more information about the music while being played during the experiments. It is of interest to investigate to what extent differences in reaction to emotion result in similar or dissimilar behavioural patterns reported in previous studies on economics decision making. We hypothesise that these emotional differences triggered by different kind of music and sound might affect influence the DMs' behaviour. An existing literature has not yet adequately verified the veracity of the familiarity effect, as previous results were, more or less, biased by the familiarity effect.

This paper describes the affection influence of the familiarity of the music and sound structure which correspond to the human performance and preference that induce behaviour. The current experiment allowed a detailed comparison of the participants' task preference and performance in the presence of familiar music and their preference and performance in the presence of unfamiliar music. In the unfamiliar music treatment, the song was used which had not been available to the public before the experiment. The co-author of the current paper, who is a composer of music, developed and composed the song used as background music for the unfamiliar music treatment that was neither downloadable nor purchasable. Thus, the current experiment was carried out with the setting, where none of the participants have had an opportunity in listening to and knowing the song before the experiment. This setting conforms to the behaviour of the DMs, who have no personal images and/or preconceived opinions of the song.

METHODOLOGY

The questions developed above can be addressed by pursuing systematic exploration into the DMs' behavioural tendencies in economic decision making, while they are presented with various background music and sound. This paper uses two types of economic decision making: One is "choice under risk", and another "intertemporal choice". Pursued is the extensive investigation of the DMs'' behavioural tendencies, adopting the methods of experimental economics.

Reliability of experimental subjects

Undergraduates were employed as paid subjects in the current experiment since undergraduates — unlike Ph.D. students and faculty members — are reliable subjects. Friedman et al.and Cassar (2004) believe that Ph.D. students and faculty members are unreliable subjects. It is on the ground that they often get interested in what the researchers doing and respond to their understanding of research topics rather than to the incentives the researchers construct. On the other hand, students seldom know much about our hypotheses (Friedman and Cassar, 2004). In addition, undergraduates are literate in language and in basic mathematics, and they have a low opportunity cost.

A question on reliability of the number of experimental subjects arises: How many experimental subjects should we use? Needless to say, our everyday life and decision making is finite and the question really is how many people are needed so that the assumptions/hypotheses are good approximation. In the current experiment, 42 participants were recruited. This conforms to the argument adduced by various authors (Cason and Friedman, 1997; Friedman, 1996; Friedman and Cassar, 2004; Smith, 1982): Laboratory work and some theory suggest that as few as three people of each type suffice for many strong economic institutions and six to eight people suffice for most games.

Financial rewards

Experimental economists adopt monetary incentives (that is, cash rewards), while most psychologists feel no necessity to offer salient rewards (Friedman and Sunder, 1994). Friedman et al.and Sunder (1994) argue that experimenters are required to motivate subjects by paying them in cash in order to create controlled economic environments in a laboratory. Most of the payment should be sensitively linked to subjects' actions in the experiment. What the DMs say they would do in hypothetical situations does not necessarily correspond to what they actually do (Bishop, 1986; Fujikawa, 2007). As in a vast number of experiments conducted by experimental economists, the participants were paid financial (monetary) rewards in the current experiments, resting upon the assertion that it is inevitable to provide the participants with the financial rewards, which are contingent on their performance in economics experiments. Indeed, employing financial rewards is considered as one of experimental standards in economics (Hertwig and Ortmann, 2001).

Computerised and non-computerised experiments

Until the mid-1970s, a huge number of economics experiments — too many to introduce here — had conducted using paper, pencil, chalkboard and a watch in standard classrooms or meeting rooms. Since the early 1980s, more and more experiments have relied on computers for data entry and in doing procedures, recording and accounting that here-to-fore had been done manually.

In spite of advantages of paper-and-pencil experiments addressed above, the current experiment was computerised. This is in the light of the fact that a number of experimental economists have so far conducted computerised experiments on the ground that the transactions cost of the experiments became miniscule in

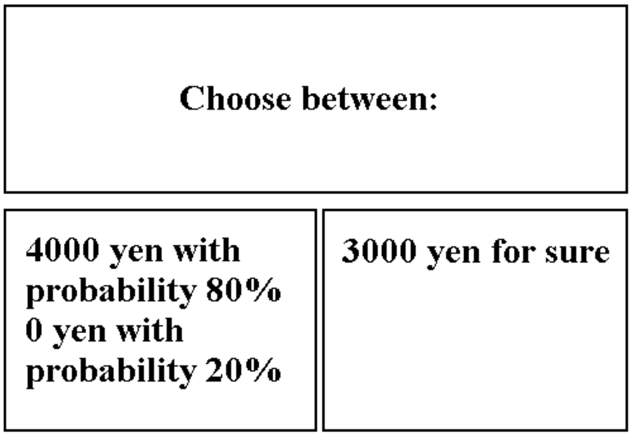

Figure 1. Experimental screen for a probability-based paradigm. **Note:** The upper part of the display shows the choice problem. The lower part shows options available to the participants. They were asked to choose (click) either of the two options.

comparison with the pre electronic days and this opened up new directions that previously had been unthinkable (Smith, 2002). Furthermore, an increasing proportion of experiments being reported today are conducted on computer networks as opposed to the face-to-face, paper-and-pencil and chalkboard mode.

Experiment

The current experiment was conducted at the Kyoto Experimental Economics Laboratory (KEEL) in Japan. On arrival at the KEEL, each participant was assigned a workstation that displayed an experimental screen, and distributed a written instruction that was read aloud. In the instructions, the participants were told that they could have a right to leave the laboratory before the experiment started, if they did not wish to participate in the experiment. The participants were also told that they were given an opportunity to ask questions individually before and during the experiment. At the conclusion of the experiment, they were paid individually and privately according to their response to choice problems, the detailed procedures of which shall be described below. The participants received no initial (showing up) fee. Decision task completion took no longer 90 min, and an average payoff was 3735 yen (about 40 US dollars at the time of the experiment) per participant.

Participants

The participants in the current experiment were 42 undergraduates from various faculties at Kyoto Sangyo University, of whom were 6 women and 36 men (M = 20.73, SD = 2.8, range = 18.34 years).

Apparatus

The experiment included four treatments:

Treatment 1 in which the participants made decisions in the presence of popular background music which will make familiarity impression;
Treatment 2 in which the participants made decisions in the presence of newly- composed background music which will make unfamiliarity impression;
Treatment 3 in which the participants made decisions in the presence of noise (white noise);
Treatment 4 in which the participants made decisions without the presence of any background music/sound.

The background music/sound was played in each treatment through personal headphones that were connected with each workstation. As the order of the four treatments was randomised, each participant took part in the four treatments in a different order. For example, the order of the treatments performed by some participants was Treatments 2, 1, 3 and 4; while the order by the other participants was Treatments 3, 4, 1 and 2. She/he started with the first treatment and participated in the second treatment. On completion of the first treatment, she/he was advised by the automatically-generated message on the computer screen that the first treatment had been completed, and a 10 min break was given before starting the second treatment. During the 10 min break, she/he participated in a questionnaire shown on the computer screen and used a mouse to respond to a set of questions. The questions included the followings: (1) How much do you know about the music play backed during treatment? (2) How much do you like the sound stimulus? (3) How much attention did you pay to the music the attention? (4) How much of your decision do you think is did you affected influenced by music stimulus you think? During the break, she/he was allowed to remove the headphone.
In each treatment, each participant was asked to respond to 30 random samples of pairwise choice problems taken by a computer programme from 120 choice problems, consisting of the following three types:

Type A: Choice under risk (that is, a choice between a p1 chance of winning x1 yen today and a p2 chance of winning x2 yen today ($p1, p2 \in (0,1]$, $p1x1 > p2x2$); Type A tasks were implemented to investigate human preference of risk.
Type B: Inter temporal choice (that is, a choice between sure y1 yen in t1 days and sure y2 yen in t2 days ($y1 > y2 > 0$ and $t1 > t2 > 0$); Type B tasks were implemented to investigate human preference of intertemporal choices.
Type C: Self-evident choice (that is, a choice between a q1 chance of winning z1 yen today and a q2 chance of winning z2 yen today ($q1, q2 \in [0,1)$, $q1 < q2$, $0 < z1 < z2$); a choice between sure z3 yen today and sure z4 yen today ($z3 > z4 > 0$)); Type C tasks were implemented to investigate human performance.

Appendix Table 1 presents the payoff structure of the 120 choice problems, of which 60 are, Type A problems; 40 are Type B problems and 20 are Type C problems. Some choice problems shared the same payoff structure. For example, two Type A problems involved a choice between 80% chance of winning 4000 yen and sure payoff of 3000 yen. Yet, the participants were presented with these problems in different paradigms: One was presented with a “probability-based” paradigm as shown in Figure 1, while another with a “description-based” paradigm as shown in Figure 2.

That is, in each treatment, each participant was given 30 choice of problems that were randomly selected for her/him by the computer programme from the pool of 120 choice problems. The participants participated took part in all of the four treatments. The order of the treatments was, however, counterbalanced to avoid the “order effect” that is concerned with an indication that the order in which items are presented can affect the strength of the decision maker’s belief (Zhang et al., 1998). In each treatment, the participants’ task was to make a selection between two options in the choice problem given at each round t (t = 1, . . . , 30). As shown in Figures 1 and 2, each of the problems was presented in their computer screen at each round t. They were asked to respond to each problem by choosing (clicking) one of two options (that is, a left button and right button in the lower panel of Figures 1 and 2) by using a computer mouse. Each problem was the independent

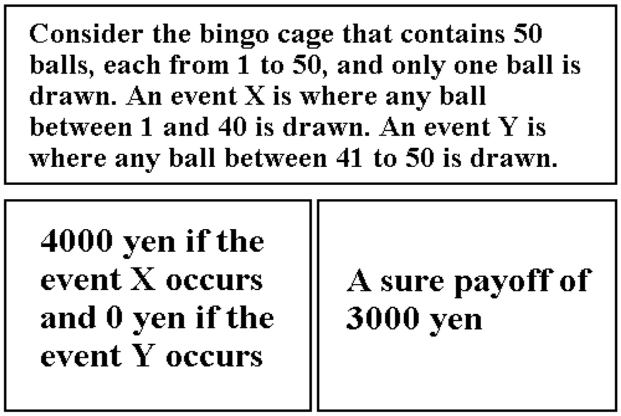

Figure 2. Experimental screen for a description-based paradigm.

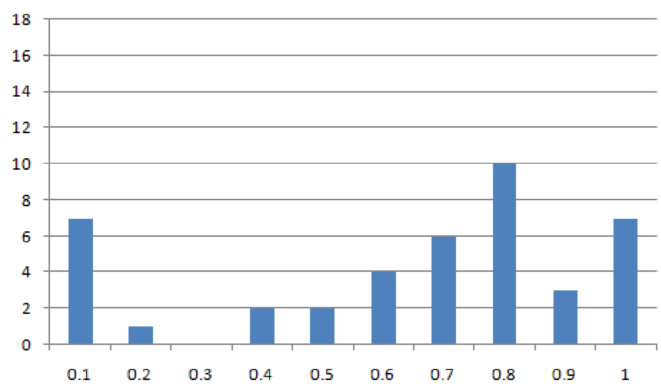

Figure 3. The distribution of P_{risky} of the individual participants in Treatment 1.
For example, we observed 6 out of 42 participants whose P_{risky} was more than 0.9.

one-shot choice problem and arranged randomly. The order of the problems and options was counterbalanced randomly across the participants. On completion of each treatment — except for Treatment 4 —, the participants were asked to fill in a questionnaire developed to clarify the participants' understanding on music preference, familiarity of the background music/sound played during the treatment and consciousness about the music/sound.

RESULTS

Treatment 1: A familiar music treatment

Stimuli

The musical piece used as background music in Treatment 1 was a popular song in Japan: a song of Doraemon — famous TV Japanimation — that was arranged by the co-author of the current paper, and used only for the experiment, the treatment 1. In the treatment, only instrumental selections (for example, piano) were employed. Hence, as stated in Milliman (1982), no concern had to be given to female versus male vocalist, popular versus less popular artists, etc. The song was arranged to piano solo score and performed by a virtual grand piano — the software synthesiser Ivory Grand Pianos standardised by VSTi that emulates "Boseudofer 290 Imperial Grand". No other particular artificial instruments were used, except for other equipments for auditory correction (that is, the equaliser, reverb and mastering effects).

The music tempo was fixed as 120 beats per minute (bpm) and loop was arranged during the treatment. (Note that 1 loop is 1 min.) The sound pressure of the 2 MIX source was normalised as -15 dB and its range is −∞ dB to -0.1 dB (no clip). The format of sound source was 16 bits/44.1 kHz CD quality wave format without any compression. The average of note tone was C4; the highest note was G5 and; the lowest note was B2 (as chromatic scale). The density of notes was 250 notes per minute. Average velocity of note was 100 (highest: 127, lowest: 64). The volume of the music was maintained at a constant level with the headphones.

The volume among each participant was all the same and fixed to proper loudness through the treatment continuously. Results of the questionnaire revealed that the participants expressed neither discomfort nor distaste for the music played during the treatment.

Results

An overall proportion of risky choices (P_{risky}) was 0.5. We observed the existence of heterogeneity among the participants in behavioural tendencies in the treatment. For example, P_{risky} of some participants was 1; while P_{risky} of other participants was nearly 0.1. Figure 3 presents the distribution of the individual P_{risky} in the treatment (SD = 0.27). Figure 5 presents the distribution of P_{risky} of the individual problems (SD = 0.23).

An overall proportion of sooner choices (P_{sooner}) was 0.6. We observed the existence of heterogeneity among the participants in behavioural tendencies in the treatment. Figure 4 presents the distribution of the individual P_{sooner} in the treatment (SD = 0.32). Figure 6 presents the distribution of P_{sooner} of the individual problems (SD = 0.26).

An overall proportion of rational choices (that is, higher payoffs with lower risk, or higher payoffs with sooner) made among Type C problems was 1. We posit in this paper that, given a choice between a q1 chance of winning z1 yen today and a q2 chance of winning z2 yen today ($q1, q2 \in [0, 1)$, $q1 \le q2$, $0 < z1 < z2$), it is rational for people to choose a q1 chance of winning z1 yen today. We also posit that, given a choice between sure z3 yen today and sure z4 yen today ($z3 > z4 > 0$), it is rational for people to choose sure z3 yen today.

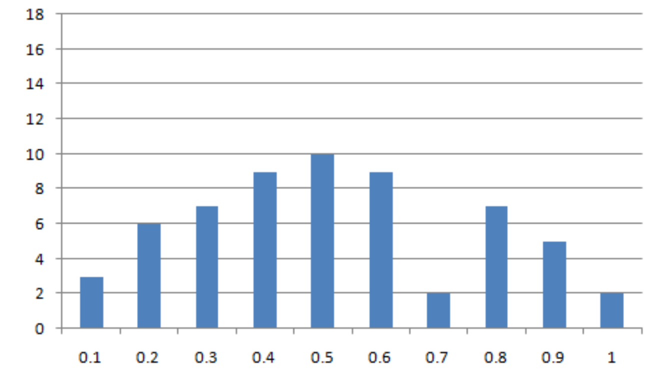

Figure 4. The distribution of P_{sooner} of the individual participants in Treatment 1.

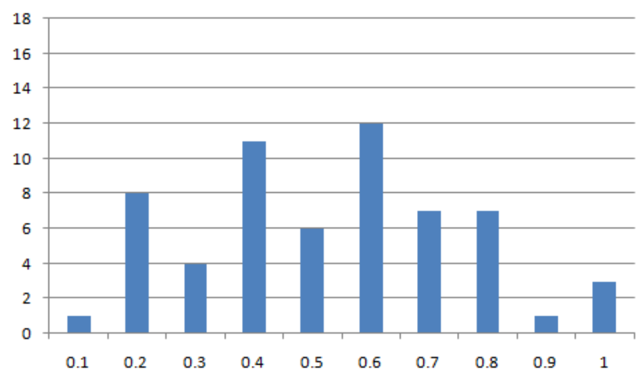

Figure 5. The distribution of P_{risky} of the individual Type A problems in Treatment 1. For example, 1 out of 60 Type A problems (i.e., Problem 6) was observed, where $0.8 < P_{risky} \leq 0.9$.

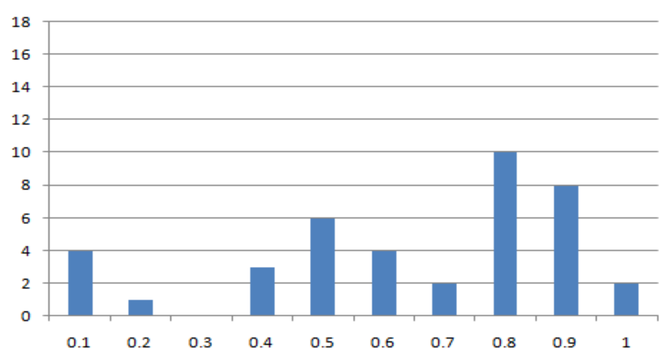

Figure 6. The distribution of P_{sooner} of the individual Type A problems in Treatment 1.

Questionnaire analysis

On completion of the treatment, the participants were asked to fill in a questionnaire developed to clarify the participants' understanding on music preference, familiarity of background music played during the treatment and consciousness about the music. The questionnaire contained questions that were: (1) how familiar do you think the music played during this treatment is? The participants rated on an 11-point scale (0 = not familiar with; 10 = very much familiar with). (2) How much do you like the sound stimulus? The participants rated on an 11-point scale (0 = dislike very much; 10 = like very much). (3) How much attention did you pay to the sound stimulus? The participants rated on an 11-point scale (0 = no attention at all; 10 = very much attention). (4) To what extent do you think your decisions are influenced by the music? The participants rated on a 11-point scale (0 = to no extent; 10 = to a very large extent).

Results of the questionnaire revealed that: First, the familiarity level was extremely high (Min = 9, Max = 10, M = 9.90, SD = 0.37); Second, the self-reported attention level was high (Min = 0, Max = 10, M = 7.47, SD = 2.97); Third, self-reported music liking was high (Min = 0, Max = 10, M = 7.76, SD = 2.56). Fourth, self-reported influence of the music on the participants' decision-making behaviour was low (Min = 0, Max = 10, M = 3.00, SD = 3.14).

On completion of the treatment, the participants were asked to fill in a questionnaire developed to clarify the participants' understanding on music preference, familiarity of the background music played during the treatment and consciousness about the music. The questionnaire contained questions that were: (1) Was the music played during this treatment familiar to you? (2) How much attention did you pay to the music during this treatment? (3) Do you like the music? (4) Do you think your decision-making behaviour was influenced by the music?

The questionnaire analysis also revealed the following: First, the self-reported familiarity level of the music on an 11-point scale (0=not familiar with; 10=very much familiar with) was extremely high (Min = 9,Max = 10,M = 9.90, SD =0.37). Second, the self-reported attention level (that is, how much attention paid to the music while making decisions) on an 11-point scale (0=no attention at all; 10=very much attention) was high (Min = 0, Max = 10, M = 7.47, SD = 2.97). Third, self-reported music liking on a 11-point scale (0=dislike very much; 10=like very much) was high (Min = 0, Max = 10, M = 7.76, SD = 2.56). Fourth, self-reported influence of the music on decision-making behaviour (that is, to what extent the participants' decision-making behaviour was influenced by the music) on an 11-point scale (0=to no extent; 10=to a very large extent) was low (Min = 0, Max = 10, M = 3.00, = 3.14).

Treatment 2: An unfamiliar music treatment

Stimuli

The musical piece used as background music in Treatment 2 was a new song composed and arranged by the co-author of the current paper, and used only for the

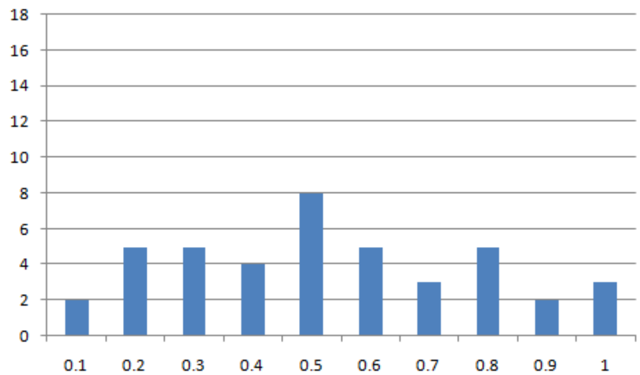

Figure 7. The distribution of P_{risky} of the individual Type A problems in Treatment 2.

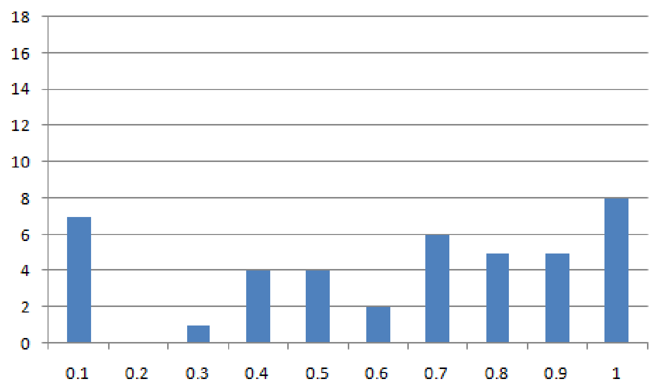

Figure 8. The distribution of P_{sooner} of the individual Type A problems in Treatment 2.

experiment treatment. In the treatment, only instrumental selections (for example, piano) were employed. The song was arranged to piano solo score and performed by a virtual grand piano — the software synthesiser Ivory Grand Pianos standardized by VSTi that emulates “Boseudofer 290 Imperial Grand”. No other particular artificial instruments were used, except for equipments for auditory correction (that is, the equaliser, reverb and mastering effects). The music tempo was fixed as 120 bpm and loop was arranged throughout the treatment. Note that 1 loop is 1 min and 4 s. The sound pressure of the 2 MIX source was normaliszed as -15 dB and its range is $-\infty$ dB to -0.1 dB (no clip). The format of sound source was 16 bits/44.1 kHz CD quality wave format without any compression. The average of note tone was D4; the highest note was F5 and; the lowest note was E1 (as chromatic scale). The density of notes was 250 notes per min. Average velocity of note was 100 (highest: 127, lowest: 64). The volume of the music was maintained at a constant level with the headphones. The volume among each participant was all the same and fixed to proper

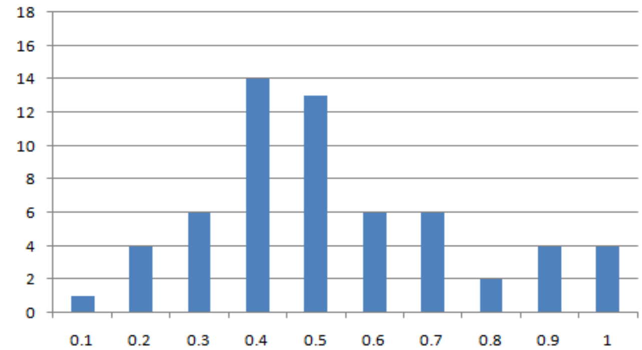

Figure 9. The distribution of P_{risky} of the individual Type A problems in Treatment 2.

loudness through the treatment continuously. Results of the questionnaire revealed that the participants expressed neither discomfort nor distaste for the music played during the treatment.

Results

With an overall P_{risky} of 0.49, we observed the existence of heterogeneity among the participants in behavioural tendencies in the treatment. For example, the P_{risky} of some participants was 1; while that of other participants was less than 0.1. Figure 7 presents the distribution of the individual P_{risky} in the treatment (SD = 0.26). Figure 8 presents the distribution of P_{risky} of the individual problems (SD = 0.23). An overall P_{sooner} was 0.57. We can see the existence of heterogeneity among the participants in behavioural tendencies in the treatment. Figure 9 presents the distribution of the individual P_{sooner} in the treatment (SD = 0.34). Figure 10 presents the distribution of P_{sooner} of the individual problems (SD = 0.29). An overall proportion of rational choices made among Type C problems was 1.

Questionnaire analysis

On completion of the treatment, the participants were asked to fill in a questionnaire that contained the same set of questions as Treatment 1. The questionnaire analysis revealed the following: First, the self-reported familiarity level of the music on an 11-point scale (0 = not familiar with; 10 = very much familiar with) was extremely low (Min = 0, Max = 6, M = 0.88, SD = 1.46). Second, the self-reported attention level on an 11-point scale (0 = no attention at all; 10 = very much attention) was moderate (Min = 0, Max = 10, M = 5.79, SD = 3.03). Third, self-reported music liking on an 11-point scale (0 = dislike very much; 10 = like very much) was high (Min = 1, Max = 10, M = 7.40, SD = 1.79). Fourth, self-reported influence of

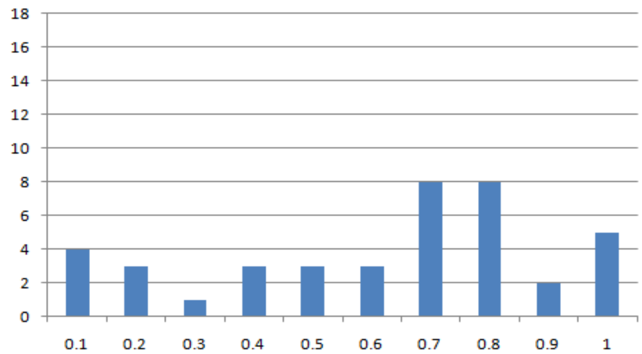

Figure 10. The distribution of P_{sooner} of the individual Type B problems in Treatment 2.

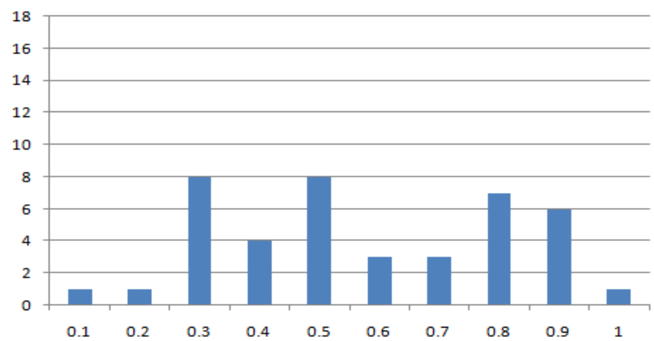

Figure 11. The distribution of P_{risky} of the individual participants in Treatment 3.

the music on decision-making behaviour on an 11-point scale (0 = to no extent; 10 = to a very large extent) was low (Min = 0, Max = 10, M = 2.98, SD = 3.09).

Treatment 3: Noise treatment

Stimuli

The background sound used in Treatment 3 was "Gaussian white noise". The format of sound source was 16bits/44.1kHz CD quality wave format without any compression, thus, the power of spectrum pattern was evenly at the range from 0 kHz to 22.1 kHz. The sound pressure was normalized as -20 dB, thus the wave form was slightly different from an ideal wave form. Amplitude over bit range was cut off. The sound pressure was lower than the other music treatments. This is because the perception of this stimulus would be higher than other musical stimulus, and we feel more loudness under the same sound pressure. To avoid the participants' un-comfortableness, the level of the sound pressure of this stimulus was decreased, so that the participants would

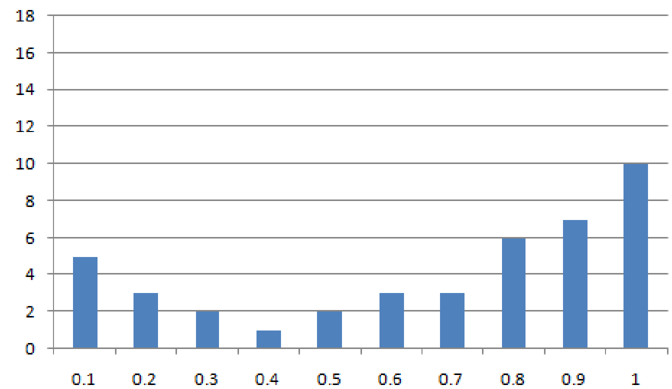

Figure 12. The distribution of P_{sooner} of the individual participants in Treatment 3.

would feel that the stimulus was as loud as the stimulus used in the other two treatments (that is, Treatments 1 and 2). The sound pattern was evenly static across the treatment. No musical pieces were used in the treatment except for white noise. The volume among each participant was all the same and fixed to proper loudness across the treatment. The questionnaire analysis re-vealed that the participants expressed neither discomfort nor distaste for the noise played during the treatment.

Results

An overall P_{risky} was 0.54. We observed the existence of heterogeneity among the participants in behavioural tendencies in the treatment. For example, P_{risky} of some participants was extremely low; while P_{risky} of other participants was high. Figure 11 presents the distribution of the individual P_{risky} in the treatment (SD = 0.24). Figure 12 presents the distribution of P_{risky} of the individual problems (SD = 0.22).

An overall P_{sooner} was 0.65. We observed the existence of heterogeneity among the participants in behavioural tendencies in the treatment. Figure 13 presents the distribution of the individual P_{sooner} in the treatment (SD = 0.34). Figure 14 presents the distribution of P_{sooner} of the individual problems (SD = 0.26).

Questionnaire analysis

On completion of the treatment, the participants were asked to fill in a questionnaire that contained questions: (1) how much attention did you pay to background noise? The participants rated on an 11-point scale (0 = no attention at all; 10 = very much attention). (2) How much do you like the sound stimulus? The participants rated on an 11-point scale (0 = dislike very much; 10 = like very much) (3) to what extent do you think your decisions are

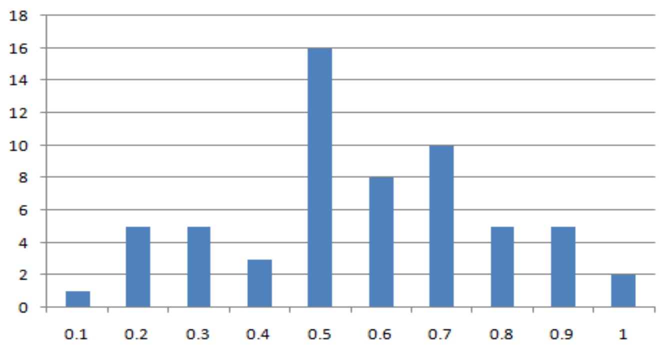

Figure 13. The distribution of P_{risky} of the individual Type A problems in Treatment 3.

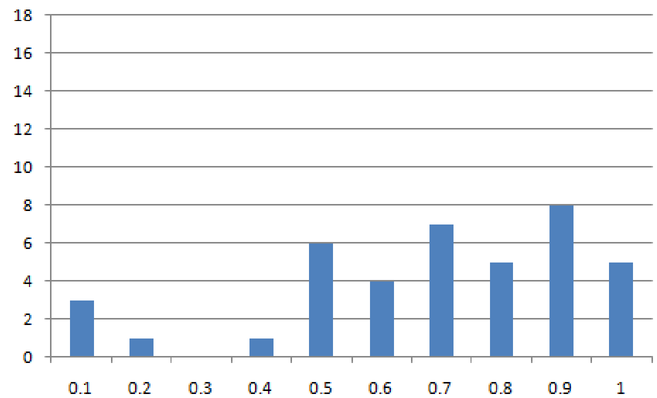

Figure 14. The distribution of P_{sooner} of the individual Type B problems in Treatment 3.

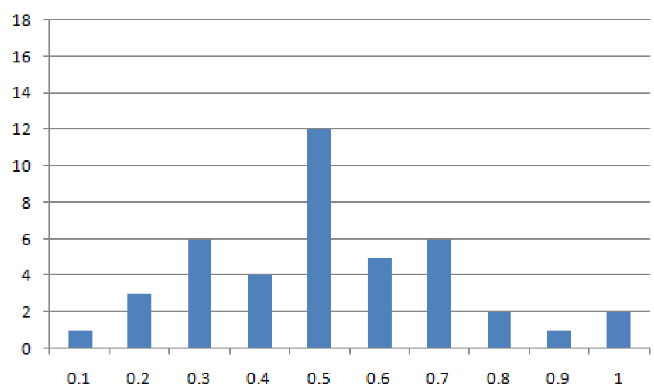

Figure 15. The distribution of P_{risky} of the individual participants in Treatment 4.

influenced by the sound stimulus? The participants rated on an 11-point scale (0 = to no extent; 10 = to a very large extent). The questionnaire aimed to clarify the participants' perception of the noise, as compared to

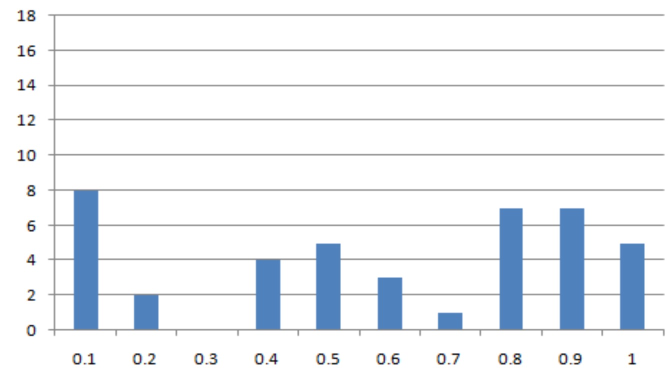

Figure 16. The distribution of P_{sooner} of the individual participants in Treatment 4.

perception of background music played in Treatments 1 and 2.

The questionnaire analysis revealed the following: First, the self-reported attention level on an 11-point scale (0=no attention at all; 10=very much attention) was moderate (Min = 0, Max = 10, M = 6.21, SD = 3.77). Second, self-reported sound liking on an 11-point scale (0=dislike very much; 10=like very much) was extremely low (Min = 0, Max = 8, M = 1.88, SD = 2.01). Third, self-reported influence of the sound on decision-making behaviour on an 11-point scale (0=to no extent; 10=to a very large extent) was low (Min = 0, Max = 10, M = 2.85, SD = 3.18).

Treatment 4: No music treatment

Stimuli

No background music/sound was used in Treatment 4. The participants were asked to engage in choice tasks in the presence neither of background music nor of background sound.

Results

An overall P_{risky} was 0.48. We observed the existence of heterogeneity among the participants in behavioural tendencies in the treatment. For example, P_{risky} of some participants was extremely low; while P_{risky} of other participants was high. Figure 15 presents the distribution of the individual P_{risky} in the treatment (SD = 0.21). Figure 16 presents the distribution of P_{risky} of the individual problems (SD = 0.24).

An overall P_{sooner} was 0.6. We observed the existence of heterogeneity among the participants in behavioural tendencies in the treatment. For example, some participants chose only sooner options, while others chose only later options. Figure 17 presents the distribution of the

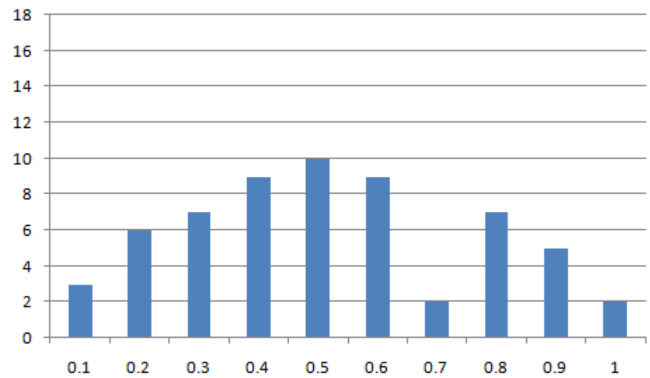

Figure 17. The distribution of P_{risky} of the individual Type A problems in Treatment 4.

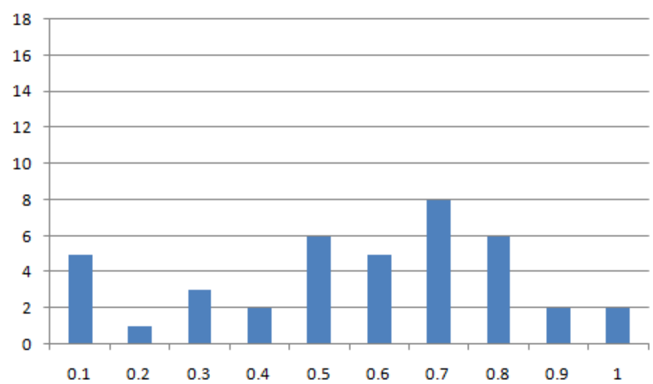

Figure 18. The distribution of P_{sooner} of the individual Type B problems in Treatment 4.

individual P_{sooner} in the treatment (SD = 0.34). Figure 18 presents the distribution of P_{sooner} of the individual problems (SD = 0.26).

Questionnaire analysis

No questionnaire was given to the participant in this treatment.

Payments to participants

In the experiment, each participant engaged in the four treatments, in each of which she/he responded to 30 pairwise choice problems. Thus, she/he responded to a total of 120 choice problems. Among all of 120 choice problems, only one choice problem was determined for which she/he was paid. The determination was made with the following steps:

Step 1: Once each participant completed all decision tasks in the last treatment, computer programmes randomly selected five out of 120 choice problems she/he had responded in the experiment. The selected five choice problems and options she/he had chosen were displayed on her/his computer screen as shown in Figure 19.

Consider the bingo cage that contains 50 balls, each numbered from 1 to 50, and only one ball is drawn. An event X is where any ball numbered between 1 and 40 is drawn. An event Y is where any ball numbered between 41 and 50 is drawn.	Sure 3000 yen
Choose between # 4000 yen with probability 80% and; # Sure 3000 yen	4000 yen with probability 80%
Choose between # Sure 2000 yen today and; # Sure 2100 yen in one week	Sure 2000 yen today
Choose between # 400 yen with probability 80% and; # Sure 300 yen	400 yen with probability 80%
Choose between # Sure 1000 yen today and; # Sure 1050 yen in one week	Sure 1050 yen in one week

Figure 19. An example of five choice problems randomly selected by computer programmes and the participant's choices. **Note:** The left column shows selected five choice problems and the right shows options chosen by her/him.

Step 2: She/he was asked to choose one of the five problems. The experimenter announced that she/he could be paid for this chosen one problem.

Step 3: This step was split into the following two different steps (that is, Steps 3-1 and 3-2), depending on a type of the choice problem chosen by her/him in Step 2 and the option of the problem chosen by her/him during the experiment.

Step 3-1: This step applied if the choice problem chosen in Step 2 involved a choice between a risky option (that is, an option yielding an uncertain payoff) and a safe option (that is, an option yielding a sure payoff), regardless of whether the choice problem was concerned with choice under risk or intertemporal choice.

If she/he had chosen the safe option, her/his cash payoff was immediately determined. Then, she/he was asked to remain seated until her/his payment was ready.

For example, if the choice problem chosen in Step 2 was to choose between a risky option that could yield 4000 yen with probability of 80% and a safe option that could yield a sure payoff of 3000 yen (that is the choice

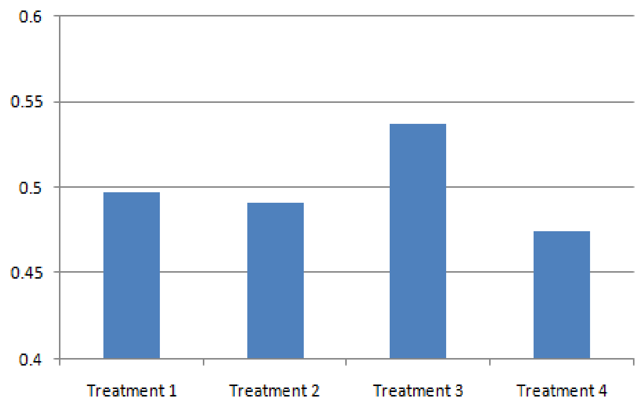

Figure 20. An overall P_{risky} in each treatment.

problems shown in the left of the first and second raws in Figure 19), and she/he had chosen the safe option, her/his award amount was immediately determined. Then, she/he was informed that she/he could be given 3000 yen shortly.

On the other hand, if she/he had chosen the risky option, she/he was presented with an empty bingo cage and a set of numbered balls. Then, she/he was asked to put these numbered balls into the empty bingo cage, and draw one ball from the bingo cage. An outcome of the risky option was determined, according to the ball drawn. The composition of the bingo cage varied, depending on the choice problem and option she/he had chosen. The preparation of the bingo cage and balls was done in view of her/him, other participants and staff at laboratory.

For example, if she/he had chosen the risky option in the abovementioned choice problem, the experimenter prepared the empty bingo cage and balls numbered 1 through 50, and asked her/him to put these 50 balls into the empty bingo cage. Then, she/he was asked to choose and write down any ten numbers from 1- 50 on a blackboard at the laboratory. Before asking her/him to draw one ball from the bingo cage, containing 50 balls, the experimenter informed her/him that she/he could be given 4000 yen if any of the balls that carried numbers you chose and wrote down on the blackboard was not drawn, otherwise no money will be received.

Step 3-2: This step applied if the choice problem she/he chose in Step 2 involved an incentive scheme that payments could be made in the future (for example, one week after the experiment). We employed Japanese practice of using “registered mail for cash” to send her/him a cash payoff, if she/he was to receive deferred payments. Postage costs were borne by the experimenter. For example, if the choice problem was to choose between “a sure payoff of 1000 yen today” and “a sure payoff of 1050 yen in one week”, and her/his choice was the latter, then 1050 yen was received by registered mail one week after the experiment.

DISCUSSION

Behavioural tendencies in the presence of background noise

Previous studies mainly focused on the discussion on to what extent background noise affects influences the decision makers’ performance. Some (Ellermeier and Hellbruück, 1998; Jones et al., 1990; Abikoff et al., 1996; Salamé and Baddeley, 1987) showed that background noise does not affect cognitive performance. Others, however, provided an account for noise-induced improvement (Usher and Feingold, 2000; Söderlund and Smaret al.,t, 2007; Baker and Holding, 1993; Zentall and Shaw, 1980) and noise-induced deterioration in cognitive performance (Schlittmeier and Hellbrück, 2009; Cassidy and Mac- Donald, 2007; Hygge et al., 2002; Ylias and Heaven, 2003).

The results of the current experiment confirm that background noise affects influences preference in decision making under risk and intertemporal decision making. On the one hand, we observed increased proclivity towards risk-taking behaviour in Type A problems in the presence of background noise. Figure 20 shows that there is a difference of P_{risky} among the four treatments. We found a significant difference in the participants’ preference in the presence of noise (that is, in Treatment 3), compared to silence (that is, in Treatment 4), when they made choice under risk. An overall P_{risky} in Treatment 3 and that in Treatment 4 were 0.54 and 0.48, respectively. The difference between these two proportions was statistically significant ($\chi^2(1) = 5.21$, $p < 0.05$), though there is no statistical difference across the four treatments ($\chi^2 (3) = 5.43$, $p > 0.05$).

On the other hand, the current results indicate a behavioural tendency that the sooner options were more opted by the participants in Treatment 3 (that is, in the presence of background noise). Figure 21 shows an overall P_{sooner} in each treatment. A significant difference was observed in the participants’ performance in the presence of noise, when they made choice between a sooner option and later option. An overall P_{sooner} was statistically different across the four treatments ($\chi^2 (3) = 19.18$, $p < 0.001$). Much attention is given here to a comparison of an overall P_{sooner} in Treatment 3 and that in Treatment 4: P_{sooner} in the former treatment and the latter were 0.65 and 0.51, respectively. The difference between these two proportions was statistically significant ($\chi^2 (1) = 18.66$, $p < 0.001$), though there was no statistical difference between: (1) P_{sooner} in Treatment 1 and 3 ($\chi^2 (1) = 3.58$, $p > 0.1$) and; (2) P_{sooner} in Treatment 1 and 4 ($\chi^2 (1) = 3.15$, $p > 0.1$).

Perception and behaviour of participants

The current experiment entailed a comparison between the participants’ task preference (that is, Type A and Type

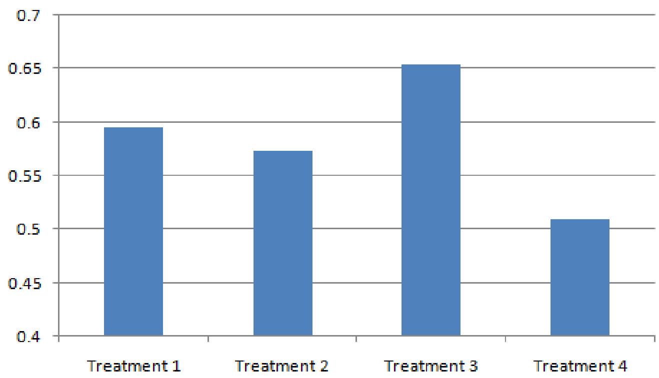

Figure 21. An overall P_{sooner} in each treatment.

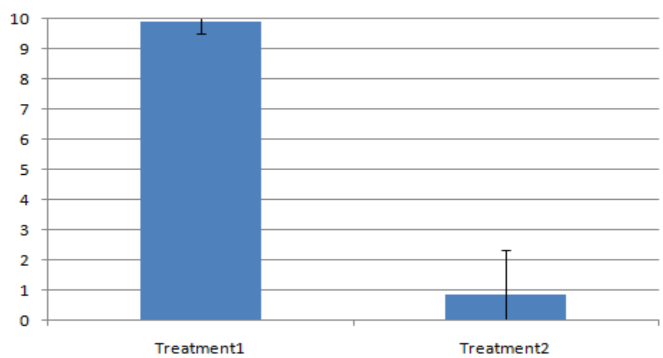

Figure 22. Mean score and standard deviation of the self-reported familiarity level (11-point scale) of the music.

B tasks) and performance (that is, Type C tasks) in the presence of familiar music stimuli (Treatment 1) and the performance in the presence of unfamiliar music stimuli (Treatment 2). This comparison was performed to observe whether the participants could exhibit the familiarity effect. We can see from Figure 22 that, there is a difference of familiarity between the music stimuli used in Treatment 1 and that in Treatment 2. This difference is statistically significant ($t = 39.25$, $p < 0.001$). However, the difference in the familiarity level does not result in a significant change in the participants' task performance, though they did perceive the music played in Treatment 1 and that in Treatment 2 as distinct. No significant difference was observed between P_{risky} in Treatment 1 and in Treatment 2. We also observed no significant difference between P_{sooner} in Treatment 1 and in Treatment 2.

In addition to music familiarity, we here focus on the participants' music/sound liking as a factor that affects influences their behaviour. A comparison between the participants' performance in the presence of music stimuli (that is, Treatment 1 and 2) and their performance in the presence of non-music stimuli (that is, Treatment 3)

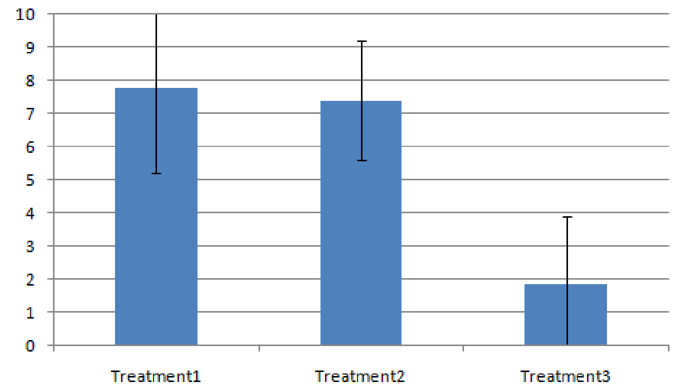

Figure 23. Mean score and standard deviation of the self-reported music/sound liking level (11-point scale).

reveals to what extent their music/sound liking affects influences their behaviour. We can see from Figure 23 that, there is a difference of the participants' music/sound liking level among Treatments 1, 2 and 3. The difference is statistically significant according to the analysis of variance ($F(2, 123) = 98.84$, $p < 0.001$). In Treatment 3, the participants made choices in the presence of white noise that was different from complex music played in Treatment 1 and 2. Results of the questionnaire indicate that many of the participants seemed to dislike the white noise, and thus be disgusted.

As we can see from Figure 20 (21), P_{risky} (P_{sooner}) was smaller in Treatment 3 than that in Treatment 1. This implies that the more the participants liked the background music/sound, the less risky choices they preferred in Type A problems; the less sooner choices in Type B problems. Hence, we would presume that the participants' music/sound liking was one of the factors of their behavioural change. We would also presume that annoyance caused by white noise stimuli led them to the risky and sooner option. One expects that future research can care to ponder other factors that affect influences behaviour, such as genres of music and sound pressure.

Were the participants conscious about their behavioural changes when exposed to different music/non-music stimuli? As we can see from Figure 24, there is a difference of the degree of attention to background music/sound across Treatments 1, 2 and 3 (that is, how much attention to background music/sound they paid to while making decisions). However, this difference is not statistically significant ($F(2, 123) = 3.03$, $p > 0.05$), contrast to the participants' degree of familiarity. We observed that their average score was higher than five in the three treatments. It means that the participants paid increasing attention to background music/sound while making decisions.

The overall participants stated in the questionnaire that they were not greatly influenced by background music/ sound in their decision making, though they did actually

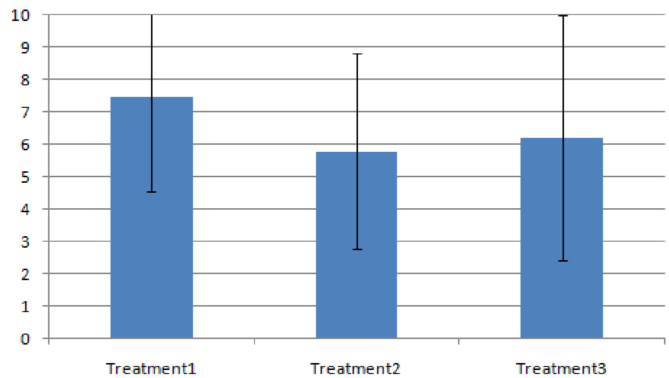

Figure 24. Mean score and standard deviation of the self-reported attention level (11-point scale) of the music/sound.

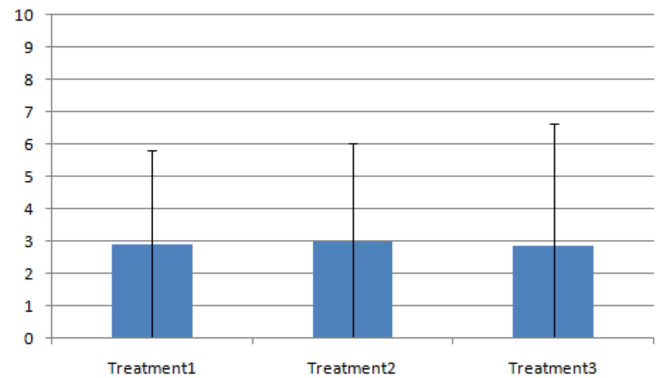

Figure 25. Mean score and standard deviation of the self-reported behavioural perception level (11-point scale) of the music/sound (that is, to what extent behaviour was influenced by background music/sound).

change their behaviour among the treatments (F(2, 123) = 0.02, p > 0.9). Figure 25 shows that an overall behavioural perception level was lower than three. This means that the participants were unconscious on their behavioural changes induced by background music/sound: The participants were conscious on their attention to background music/sound, but unconscious on their behavioural changes.

Observed and predicted behavioural tendencies

Figure 26 shows the number of the participants (X-axis) and the level of P_{risky} (Y-axis) across the four treatments sorted in an ascending order. The predicted P_{risky} was calculated based on the assumption that they randomly select options in 60 Type A problems. The difference between the predicted and observed P_{risky} is statistically significant (χ^2 (1) = 10.71, p < 0.01). If the participants randomly select options in the 60 problems (that is., they make a fifty-fifty choice between a risky option and a safe option), the prediction of P_{risky} would have a binomial distribution. For example, the likelihood of the event that P_{risky} > 0.9 would be extremely lower in the prediction than in the observation of the participants. One may argue that this is because of some particular characteristics of the problems (for example, the problem involving a choice between a 0.01% chance of winning100,000 yen and sure 100 yen), and hence the average P_{risky} might be changed. However, this is not likely to be the reason of this largely scattered distribution. We can also see the tendency of the heterogeneity as shown in Figure 5. These type of distribution cannot be explained by the standard and ordinary statistical approach.

Figure 27 shows the number of Type A problems (X-axis) and the level of P_{risky} (Y-axis) across the four treatments sorted in an ascending order. The predicted P_{risky} was calculated based on the assumption that risky and safe options are selected randomly. The difference between predicted and observed risky choices (P_{risky}) is

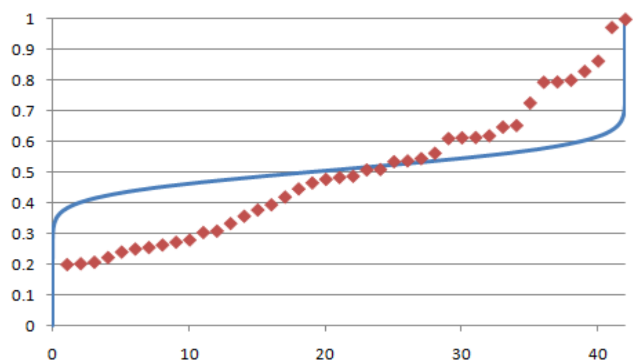

Figure 26. Predicted and observed each participant's P_{risky} across the four treatments sorted in an ascending order. The solid line corresponds to the predicted P_{risky} across 42 participants. The dotted line corresponds to the observed P_{risky} across 42 participants. For example, from the prediction, we would see only two out of 42 participants, whose P_{risky} less than 0.4; while we observed 16 participants.

statistically significant (χ^2 (1) = 15.50, p < 0.01). We see that if 42 subjects randomly selected the options in each problem, the prediction of P_{risky} would have a binomial distribution. Let us, for example, focus on the following two Type A problems:

Problem A1: Choose between:

(a) 4000 yen with probability of 0.8; 0 otherwise(b) 3000 yen with certainty

Problem A2: Choose between:

(a) 4000 yen with probability of 0.2; 0 otherwise
(b) 3000 yen with probability of 0.25; 0 otherwise

Our simulation prediction suggests that the likelihood of

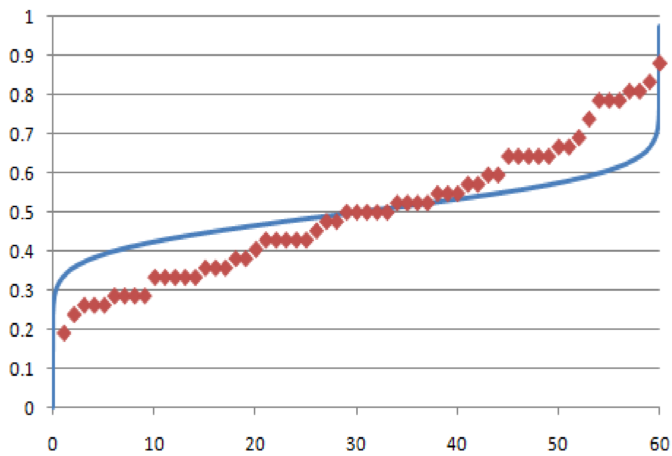

Figure 27. Predicted and observed P_{risky} of individual Type A problems across the four treatments sorted in an ascending order. The solid line corresponds to the predicted P_{risky} across 60 Type A problems. The dotted line corresponds to the observed P_{risky} across 60 Type A problems.

Table 1. P_{risky} of Problem A1 and A2.

Treatment	1	2	3	4
Problem A1	0.67	0.6	0.71	0.8
Problem A2	0.7	0.4	0.75	0.33

For example, we can see that an overall P_{risky} of Problem A1 in Treatment 2 is 0.6.

the event that $P_{risky} > 0.9$ is extremely lower in the simulation than in our observation in the experiment. Table 1 shows the P_{risky} of Problem A1 and A2 in each treatment. We can see from the Table 1 that, in all treatments, P_{risky} became less than 0.9. This result agrees with the prediction.

On the other hand, a comparison of Problem A1 and A2 gives us an insight into the violation of the "expected utility theory" — a well-known normative theory of decision making under risk formulated and axiomatised by von Neumann and Morgenstein (1944). Problem A1 and A2 are variants of the Allais paradox (Allais, 1953) that is known as one of the best known counter-example of such a violation. Here, we would like to demonstrate the Allais paradox with a comparison of Problem A1 and A2. Note that Problem A2 was created by dividing the probability of winning in Problem A1 by four. The results of the current experiment show that there is a significant difference of P_{risky} between the two problems across the treatments. That is, the participants behaved significantly differently between the two problems (χ^2 (1) =, $p < 0.01$). This behavioural pattern is a violation of the expected utility theory that implies that the participants should have the same preferences in the two problems.

Conclusion

There have been behavioural outcomes of music in marketing (Alpert and Alpert, 1988; Gorn, 1982; Milliman, 1982; Park and Young, 1986; Simpkins and Smith, 1974) and in psychology (Iwanaga and Ito, 2002; Sundstrom and Sundstrom, 1986; Wolf and Weiner, 1972). However, no attempts have been made to examine the influences of background music in economics decision making. With a toolset of experimental economics, this paper has investigated to what extent background music affects influences the DMs, who engage in decision making under risk and intertemporal decision making. The investigation has been conducted along with the assertion that music can affect influence human emotion and their behaviour, and is a way for us to make behaviour either powerful or less powerful.

It should be noted here that this paper has not discussed the influences of "levels" of noise. In the current experiment, the level of noise was fixed and set at -20 dB. Different authors, however, used different levels of noise in their experiments, involving decision tasks (for example, 62 dB and 78 dB in Carlson et al., (1997), 90 dB in Baker and Holding (1993). It is of importance to investigate the influences on levels of noise presented to the DMs during choice tasks. On the one hand, the low levels of noise may improve performance (Alain et al., 2009). Zentall and Shaw (1980) showed that high levels of noise (that is, 69 dB) were detrimental, though low levels (that is, 64 dB) were not. On the other hand, in their the experiments conducted by Söderlund and Smart, et al. (2007), they fixed and set the level of noise at 80 dB and 81 dB, and their results showed that noise can benefit performance. To claim that the level of noise is one of key determinants that affect behaviour in decision tasks that involve choice under risk and intertemporal choices, one may conduct future relevant experiments, varying levels of noise to be presented to the participants.

Findings from the current paper will contribute to us to decide what background sound to employ when people engage in decision making. Deciding right background sound in a particular decision task is crucial, as wrong background sound can produce the influences effects that totally neglect the objective of the exercise (Milliman, 1982). Thus, the findings can help managers interested in influencing behaviour of employees and consumers. It can also help bankers interested in influencing behaviour of investors, that is, interested in inducing the investors to buy low-risk assets (for example, government bonds) and high-risk assets (for example, mutual funds).

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APPENDIX

Table 1. Pay off structure of choice problems.

Problem	Option A				Option B				Category
	Win	Lose	Probability of winning	Delay	Win	Lose	Probability of winning	Delay	
1	8000	0	0.4	0	3000	0	1	0	A
2	4000	0	0.8	0	3000	0	1	0	A
3	3200	0	0.2	0	400	0	0.8	0	A
4	2200	0	0.5	0	1000	0	1	0	A
5	2000	0	0.4	0	1200	0	0.6	0	A
6	4000	0	0.2	0	3000	0	0.25	0	A
7	3200	0	0.1	0	300	0	1	0	A
8	4000	0	0.8	0	3000	0	1	0	A
9	5000	0	0.2	0	1000	0	1	0	A
10	5000	0	0.5	0	2500	0	1	0	A
11	400	0	0.8	0	300	0	1	0	A
12	3200	0	0.1	0	300	0	1	0	A
13	4000	0	0.2	0	3000	0	0.25	0	A
14	7200	0	0.4	0	2700	0	1	0	A
15	3600	0	0.8	0	2700	0	1	0	A
16	2880	0	0.2	0	360	0	0.8	0	A
17	1980	0	0.5	0	900	0	1	0	A
18	1800	0	0.4	0	1080	0	0.6	0	A
19	3600	0	0.2	0	2700	0	0.25	0	A
20	2880	0	0.1	0	270	0	1	0	A
21	3600	0	0.8	0	2700	0	1	0	A
22	4500	0	0.2	0	900	0	1	0	A
23	4500	0	0.5	0	2250	0	1	0	A
24	360	0	0.8	0	270	0	1	0	A
25	2880	0	0.1	0	270	0	1	0	A
26	3600	0	0.2	0	2700	0	0.25	0	A
27	6400	0	0.4	0	2400	0	1	0	A
28	3200	0	0.8	0	2400	0	1	0	A
29	2560	0	0.2	0	320	0	0.8	0	A
30	1760	0	0.5	0	800	0	1	0	A
31	1600	0	0.4	0	960	0	0.6	0	A
32	3200	0	0.2	0	2400	0	0.25	0	A
33	2560	0	0.1	0	240	0	1	0	A
34	3200	0	0.8	0	2400	0	1	0	A
35	4000	0	0.2	0	800	0	1	0	A
36	4000	0	0.5	0	2000	0	1	0	A
37	320	0	0.8	0	240	0	1	0	A
38	2560	0	0.1	0	240	0	1	0	A
39	3200	0	0.2	0	2400	0	0.25	0	A
40	5600	0	0.4	0	2100	0	1	0	A
41	2800	0	0.8	0	2100	0	1	0	A
42	2240	0	0.2	0	280	0	0.8	0	A
43	1540	0	0.5	0	700	0	1	0	A
44	1400	0	0.4	0	840	0	0.6	0	A
45	2800	0	0.2	0	2100	0	0.25	0	A
46	2240	0	0.1	0	210	0	1	0	A
47	2800	0	0.8	0	2100	0	1	0	A
48	3500	0	0.2	0	700	0	1	0	A

Table 1. Cont'd.

49	3500	0	0.5	0	1750	0	1	0	A
50	280	0	0.8	0	210	0	1	0	A
51	2240	0	0.1	0	210	0	1	0	A
52	2800	0	0.2	0	2100	0	0.25	0	A
53	2000	0	0.4	0	1000	0	0.8	0	A
54	1900	100	0.5	0	1000	0	1	0	A
55	1800	0	0.4	0	900	0	0.8	0	A
56	1710	90	0.5	0	900	0	1	0	A
57	1600	0	0.4	0	800	0	0.8	0	A
58	1520	80	0.5	0	800	0	1	0	A
59	1400	0	0.4	0	700	0	0.8	0	A
60	1330	70	0.5	0	700	0	1	0	A
61	5000	0	1	0	5500	0	1	7	B
62	5000	0	1	0	5005	0	1	1	B
63	5000	0	1	0	5050	0	1	1	B
64	5000	0	1	0	5010	0	1	7	B
65	5000	0	1	0	5020	0	1	14	B
66	5000	0	1	0	5500	0	1	14	B
67	5000	0	1	0	5050	0	1	30	B
68	1000	0	1	7	2000	0	1	14	B
69	1000	0	1	7	1100	0	1	30	B
70	5000	0	1	0	5500	0	1	30	B
71	4500	0	1	0	4950	0	1	7	B
72	4500	0	1	0	4504	0	1	1	B
73	4500	0	1	0	4545	0	1	1	B
74	4500	0	1	0	4509	0	1	7	B
75	4500	0	1	0	4518	0	1	14	B
76	4500	0	1	0	4950	0	1	14	B
77	4500	0	1	0	4545	0	1	30	B
78	900	0	1	7	1800	0	1	14	B
79	900	0	1	7	990	0	1	30	B
80	4500	0	1	0	4950	0	1	30	B
81	4000	0	1	0	4400	0	1	7	B
82	4000	0	1	0	4004	0	1	1	B
83	4000	0	1	0	4040	0	1	1	B
84	4000	0	1	0	4008	0	1	7	B
85	4000	0	1	0	4016	0	1	14	B
86	4000	0	1	0	4400	0	1	14	B
87	4000	0	1	0	4040	0	1	30	B
88	800	0	1	0	1600	0	1	14	B
89	800	0	1	7	880	0	0	30	B
90	4000	0	1	0	4400	0	0	30	B
91	3500	0	1	0	3850	0	0	7	B
92	3500	0	1	0	3503	0	0	1	B
93	3500	0	1	0	3535	0	0	1	B
94	3500	0	1	0	3507	0	0	7	B
95	3500	0	1	0	3514	0	0	14	B
96	3500	0	1	0	3850	0	0	14	B
97	3500	0	1	0	3535	0	0	30	B
98	700	0	1	7	1400	0	0	14	B
99	700	0	1	7	770	0	0	30	B
100	3500	0	1	0	3850	0	0	30	B

Table 1. Contd.

101	2000	0	1	0	1000	0	0	0	C
102	1000	0	1	0	500	0	0	0	C
103	2000	0	0.5	0	1000	0	0.5	0	C
104	2000	0	1	0	500	0	1	0	C
105	1800	0	1	0	900	0	1	0	C
106	900	0	1	0	450	0	1	0	C
107	1800	0	0.5	0	900	0	0.5	0	C
108	1800	0	1	0	450	0	1	0	C
109	1600	0	1	0	800	0	1	0	C
110	800	0	1	0	400	0	1	0	C
111	1600	0	0.5	0	800	0	0.5	0	C
112	1600	0	1	0	400	0	1	0	C
113	1400	0	1	0	700	0	1	0	C
114	700	0	1	0	350	0	1	0	C
115	1400	0	0.5	0	700	0	0.5	0	C
116	1400	0	1	0	350	0	1	0	C
117	2000	0	0.5	0	2000	0	0.6	0	C
118	1800	0	0.5	0	1800	0	0.6	0	C
119	1600	0	0.5	0	1600	0	0.6	0	C
120	1400	0	0.5	0	1400	0	0.6	0	C

Summary of the payoff structure problems. For example, Problem 61 involved a choice between Option A yielding the present 5000 yen and Option B yielding 5500 yen in 7 days, while Problem 103 involved a choice between Option A yielding a 50% chance of winning present 2000 yen and Option B yielding a 50% chance of winning present 1000 Yen.