

THE REPEATED RECORDING ILLUSION: THE EFFECTS OF EXTRINSIC AND INDIVIDUAL DIFFERENCE FACTORS ON MUSICAL JUDGMENTS

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THE REPEATED RECORDING ILLUSION REFERS TO the phenomenon in which listeners believe to hear different musical stimuli while they are in fact identical. The present paper aims to construct an experimental paradigm to enable the systematic measurement of this phenomenon, investigating potentially related extrinsic and individual difference factors. Participants were told to listen to “different” musical performances of an original piece when in fact they were exposed to the same repeated recording. Each time, the recording was accompanied by a text suggesting a low, medium, or high prestige of the performer. Most participants (75%) believed that they had heard different musical performances. Participants with high levels of neuroticism and openness were significantly more likely to fall for the illusion. While the explicit information presented with the music influenced participants’ ratings significantly, the effect of repeated exposure was only significant in the more familiar music condition. These results suggest that like many other human judgments, evaluations of music also rely on cognitive biases and heuristics that do not depend on the stimuli themselves. The repeated recording illusion can constitute a useful paradigm for investigating nonmusical factors because it allows for the study of their effects while the music remains the same.

Received: September 22, 2016, accepted February 24, 2017.

Key words: aesthetics, individual differences, explicit information, music performance, judgments and preferences

IN 1977, THE GERMAN RADIO STATION WDR 3 conducted an audience participation experiment during a live program (see the description in Behne, 1987). The radio broadcaster misled the audience to think that they would hear three different performances of the same excerpt of Bruckner’s Symphony No. 4,

providing brief information about three different conductors (Karl Böhm, Leonard Bernstein, and Herbert von Karajan) just before each recording was played. However, the radio broadcaster played the same recording three times. The radio station received 536 calls. 81.7% of the callers were misled and reported differences between the identical music recordings. Only the remaining 18.3% of the listeners who called in reported that there were no differences between the three performances. Nevertheless, we note that the audience participation experiment had several shortcomings, such as a lack of control over experimental conditions and a potential sampling bias for those listeners who believed they had heard different musical performances to call the radio station. Therefore, one of the main motivations of the present paper was the replication of this phenomenon in an experimental setting.

We will refer to this phenomenon, where listeners are under the impression that they hear different musical performances while in fact they are identical, as *the repeated recording illusion*. Duerksen (1972) was amongst the first academic studies to use a similar approach. He played two tape recordings of an identical piano performance to music major and nonmusic major students. Participants were told that one performance was by an eminent professional pianist and the other one by a student. Both groups rated technical and musical characteristics of the music recording consistently lower when told the performance was by a student than when told it was by a professional. However, Duerksen (1972) merely attributed the findings to an effect of expectations and did not investigate whether participants believed that they had heard the same or different musical performances.

There are a number of studies that used similar experimental paradigms, presenting participants with identical recordings in succession (Behne & Wöllner, 2011; Cavitt, 1997, 2002; Elliott, 1995; Griffiths, 2008; Juchniewicz, 2008; Radocy, 1976; Silvey, 2009). The main purpose of these studies was to investigate nonmusical factors that influence evaluations of musical performances, such as the effect of expectations (Cavitt, 1997, 2002; Duerksen, 1972), authority (Radocy, 1976), musicians’ body movements (Behne & Wöllner,

2011; Juchniewicz, 2008), race and gender (Elliott, 1995), concert dress and physical attractiveness (Griffiths, 2008), and band labels (Silvey, 2009). None of these studies considered the implications of participants potentially falling for the repeated recording illusion. Thus, in none of these studies it is possible to determine whether the illusion occurred in the sample of participants. We considered the repeated recording illusion to be a phenomenon that merits further investigation. Exploring this phenomenon in detail could provide relevant and unique insights to the fields of aesthetics, music perception, cognition, and choice behavior. Therefore, the present study attempts to measure systematically the repeated recording illusion, investigating individual difference factors that contribute to it as well as extrinsic factors responsible for differences in musical judgments when the acoustic input remains the same.

In relation to the individual difference factors, we suggest that the amount of music training of participants may play an important role in the repeated recording illusion. A large number of previous studies have shown that people with high levels of music training (i.e., musicians) outperform nonmusicians on many music-related tasks, indicating that music training has a positive influence on the efficiency and accuracy with which characteristics of sounds (e.g., pitch and timbre) are encoded in memory (see Pearce, 2015, for a review). For instance, musicians are more attuned to small variations and nuances in music (Deliège, 1987) and have better recognition memory for melody than nonmusicians (Dowling, 1978; Dowling & Bartlett, 1981; Halpern, Bartlett, & Dowling, 1995; Orsmond & Miller, 1999). We therefore hypothesized that music training would have an effect on the illusion. However, the tasks involved in the above research (e.g., to recognize a melody) are very different from the task that requires an individual to realize that the same music recording is played in succession. Thus, it is difficult to predict the direction in which music training may affect the repeated recording illusion. The present study only attempts to assess whether musicians perform differently on this task compared to nonmusicians.

Arguably, the paradigm used in the repeated recording illusion relies on a judgment bias exerted by a figure of authority (i.e., participants are told by a researcher in a lab condition that they will listen to different performances). In line with Milgram's (1963) obedience to authority experiment, Radocy (1976) found that the bias exerted by a figure of authority significantly influenced participants' evaluations of musical events. We therefore considered that individual differences on suggestibility

could be an important factor contributing to the illusion. We hypothesized that people with higher levels of suggestibility would be more likely to fall for the repeated recording illusion.

The present research also explored music preferences and personality as possible individual difference factors related to the illusion. Individuals tend to have stronger preferences for certain genres of music, becoming more familiar with the preferred style as a result of repeated listening. Repeated exposure to a piece of music increases the liking for it and decreases its subjective complexity (see North & Hargreaves, 2008, for a review). In relation to personality, research shows that personality traits relate to specific preferences for music styles (see Greasley & Lamont, 2016, for a review). For instance, openness to experience is positively linked to preference for reflective and complex styles (e.g., classical music) (Rentfrow & Gosling, 2003). Furthermore, research on individual differences has found links between personality and suggestibility, showing, for example, a positive (but low) relationship between suggestibility and neuroticism (see Gudjonsson, 2003, for a review). Therefore, we hypothesized that preferences for music style and personality traits would affect participants' susceptibility to the repeated recording illusion, although we could not specify in which direction.

Extrinsic factors that may be responsible for differences in musical judgments when the acoustic input is identical include the effect of explicit information. Presenting music with explicit information has been shown to be influential in the evaluation of musical performances (Cassidy & Sims, 1991; Cavitt, 1997, 2002; Kroger & Margulis, 2016; Margulis, 2010; Margulis, Kisida, & Greene, 2015; North & Hargreaves, 2005; Silveira & Diaz, 2014; Silvey, 2009; Vuoskoski & Eerola, 2013). In an fMRI study, Kirk, Skov, Hulme, Christensen, and Zeki (2009) presented the same images of artworks with different contextual information, varying in prestige (i.e., labeled as "gallery" or "computer generated"). The findings revealed that when the artworks were labeled as "gallery" they were rated higher in an aesthetic value scale than when labeled as "computer generated." The fMRI data showed more activity in the medial orbito-frontal cortex under the gallery context compared to the computer one, suggesting a neural system supporting contextual modulation of aesthetic ratings. In the present study, we hypothesized that participants would evaluate the same recording more positively when presented with a text suggesting high prestige of the performer than when presented with texts of lower prestige levels.

Another important extrinsic factor responsible for differences in musical judgments when the acoustic

input is identical may be the effect of repeated exposure. In line with the domain-general mere exposure effect (Zajonc, 1968), the liking of an initially neutral stimuli increases with repeated exposure. While the effect of mere exposure has been extensively studied using particular pieces of music as stimuli (see North & Hargreaves, 2008, for a review), only a few studies have examined this effect on evaluations of performances of individual pieces. In a recent study, Kroger and Margulis (2016) presented participants with pairs of solo piano performances and informed them that one was played by a conservatory student and the other by a world-renowned professional. After listening to each pair, participants had to select which they considered to have been performed by the professional. The results indicated that participants selected the second performance as professional more frequently than the first performance, although this effect was modulated by the actual identity of the performer. In relation to the repeated recording illusion, we hypothesized that participants' ratings of the same recording would improve with repeated exposure.

The present research had three main aims. The first was to construct an experimental paradigm to enable the systematic measurement of the repeated recording illusion. The second aim was to investigate possible individual difference factors that contribute to the illusion (i.e., music training, suggestibility, music preferences, and personality). The third aim was to investigate extrinsic factors responsible for differences in musical judgments when the acoustic input remains the same (i.e., explicit information and repeated exposure). In addition, in order to capture higher-order interactions between the extrinsic and individual difference factors, an exploratory analysis of the same data aimed to identify conditions that lead to particularly positive or negative judgments.

In constructing the experimental paradigm of the repeated recording illusion, participants were misled to think that they had heard three different performances of an original music piece. However, we played the exact same recording three times in succession. Each time the recording was accompanied by a text suggesting low, medium, or high prestige of the performer. We repeated this experimental procedure with two different pieces of music, a piece of classical music and a piece of popular music for which we assumed a high stylistic familiarity for most participants. In order to study the repeated recording illusion without an effect of explicit information, we examined a nonprestige group where we did not manipulate prestige of the performer.

Method

PARTICIPANTS

A sample of seventy-two university students took part in the experiment (36 male, 36 female), aged 19-39 ($M = 24.26$, $SD = 3.60$). Twenty-nine participants were considered as trained musicians ($M = 45.74$, $SD = 5.73$ on the Musical Training subscale of the Goldsmiths Musical Sophistication Index; Müllensiefen, Gingras, Musil, & Stewart, 2014; and had 6 to 8 years of formal music training). Forty-five participants were considered as nonmusicians ($M = 22.71$, $SD = 7.34$ on the Gold-MSI; and had 1 year of formal music training on average). Twelve participants were randomly allocated to a nonprestige condition (6 male, 6 female), aged 21-29 ($M = 24.34$, $SD = 3.45$). Participation was on a volunteer basis and unpaid.

DESIGN

The study employed a $3 \times 3 \times 2$ repeated measures design. Explicit information (low vs. medium vs. high prestige text), repeated exposure (first vs. second vs. third position), and genre of the original music piece (popular vs. classical music) were the within-participant factors. The three levels of the explicit information factor were fully counterbalanced with presentation order across participants. Half of the participants started with the popular music piece condition and the other half started with the piece of classical music. The dependent variables consisted of a diverse range of musical judgments provided immediately after each listening and at the end of each music condition. In order to explore the repeated recording illusion without an effect of explicit information, we examined a nonprestige group where we did not manipulate prestige of the performer. In addition, we measured individual difference factors that were expected to contribute to the illusion (i.e., music training, suggestibility, music preferences, and personality).

MATERIALS

In the popular music condition participants listened to a live recording of "Jailhouse Rock" by Elvis Presley, recorded in NBC studios in 1968. The length of the recording was 1 minute and 36 seconds. This piece was selected because we assumed a high stylistic familiarity for most participants. In the classical music condition participants listened to the final part of a live recording of Bruckner Symphony No. 4 "Die Romantische," conducted by Günter Wand and performed by the Berliner Philharmonic Orchestra in 1998. The length of the recording was 2 minutes and 48 seconds. This piece was selected in order to replicate empirically the experiment

carried out in the German radio station WDR 3 (Behne, 1987). The original recordings were edited and normalized using *ableton live* computer software. In the popular live recording we edited the start and end points of the original recording in order to contain only the musical performance element of the recording. Similar to the German radio experiment (Behne, 1987), the start and end points of the classical music piece were edited to contain the final part of the performance. We then normalized the volume of the two recordings to be fixed on the same threshold. Then each recording was duplicated three times and written to the same compact disc, using *iTunes 12.2.2*. Each copy of the music recording was saved under a different name, which included performers' names as used in the texts suggesting different levels of prestige. In the nonprestige condition, the names were Performance 1, Performance 2, and Performance 3.

To manipulate the effect of explicit information we created three texts suggesting low, medium, and high prestige of the performer. The texts had the same format, organization and a length of 150 words. In the popular music condition ("Jailhouse Rock"), the three "different" performers were presented as different Elvis impersonators. The prestige texts provided information about the three impersonators, who differed on skill and success (Appendix A). In the classical music condition (Bruckner's Symphony No. 4), the three 'different' performers were presented as different classical conductors. The prestige texts provided information about the conductors, who differed on skill and success (Appendix B). Günter Wand, the actual conductor of the recording, was not among these conductors. In the nonprestige condition, three different texts were created with the same format, organization and length of 150 words. While in the popular music condition the three texts provided neutral information from different parts of Elvis Presley's biography, in the classical music condition the texts provided neutral information from different parts of Anton Bruckner's biography.

In order to evaluate liking as well as more objective aspects of the performance (e.g., pitch accuracy and tempo appropriateness), we designed an evaluation form consisting of ten Likert rating scales and two open-text boxes. Nine of the rating scales consisted of sliders ranging from 0 to 100. The rating scales were provided to evaluate the following dimensions: (1) liking of the interpretation, (2) timing and rhythm, and (3) tone quality (from *dislike strongly* to *like strongly*), (4) tempo appropriateness (from *very inappropriate* to *very appropriate*), (5) pitch accuracy (from *very inaccurate* to *very accurate*), (6) emotional quality and (7) overall

quality of the performance (from *very bad* to *very good*), and degree of agreement to two statements: (8) *some aspects regarding the singer's vocal technique/orchestral technique could be improved*, and (9) *some aspects of the overall interpretation could improve* (from *strongly disagree* to *strongly agree*). In addition, (10) participants were asked to rate each recording using a 5-star rating scale, ranging from 1 star (*strongly dislike*) to 5 stars (*like strongly*). The Likert rating scales were designed to examine differences in musical judgments when the acoustic input is the same. After the ten Likert rating scales, two open-text boxes were provided where participants could write down anything to describe the performance and whether or not they enjoyed it. Answering the open-text boxes was optional.

At the end of each music condition, participants were requested to fill out a final evaluation form. In this final evaluation, participants were asked to rate how much they liked each recording compared to the others, on a scale from 0 (much less than the others) to 100 (much more than the others), where the midpoint of the scale ("50") was labeled as *as much as the others*. Participants also had to evaluate the familiarity to the original piece of music, on a scale from 0 (*don't know at all*) to 100 (*know very well*). In all rating scales, participants were able to see the number attributed to their specific rating. We also provided an open-text box where participants could write down any optional comments regarding the experience of the experiment. The information from the open-text boxes was used to determine whether participants fell for the illusion or not. When the information from the open-text boxes was not sufficient to make a clear and objective decision, the final comparative rating scales were taken into consideration to determine whether participants fell for the illusion or not. The open-text boxes were used in conjunction with the final comparative rating scales, designed to address a clear limitation in this experiment: we could not ask participants explicitly whether the recordings were the same or different as this would have biased their subsequent evaluations and behavior in the experiment.

In order to measure the individual difference factors, participants filled out different questionnaires corresponding to each factor. To measure participants' music training and active engagement with music we used the Goldsmiths Musical Sophistication self-report questionnaire (Gold-MSI, Müllensiefen et al., 2014). To measure participants' suggestibility, we used the Social Desirability Scale (SDS-17) (Stöber, 2001) and 8 items adopted from the Susceptibility Persuasive Strategies Scale (STPS) (Kaptein, Ruyter, Markopoulos, & Aarts, 2012), which measured bias to authority, consensus, and

persuadability, used in a previous study (Unal, Temizel, & Eren, 2014). To assess music preferences and stylistic familiarity, we used the Short Test of Music Preferences revised (STOMP-R, Rentfrow & Gosling, 2003). To measure personality, we used the Big Five Inventory (BFI) (John & Srivastava, 1999).

PROCEDURE

Participants were tested individually in small cubicle rooms. They listened to the music recordings using professional headphones (KNS 8400 Studio Headphones, KRK systems) and at a comfortable listening level that could be adjusted by the individual participants prior to the actual experiment. Participants were told that the main purpose of the study was to measure people's skills in evaluating technical and musical aspects of different musical performances of the same original piece. After filling out the Gold-MSI questionnaire, participants were instructed to listen to three different interpretations of the same piece of music and to evaluate them as accurately as possible. Before listening to each recording, participants were presented with the corresponding text suggesting different levels of prestige. Immediately after reading the text participants listened to the recording. Immediately after listening to each recording, participants completed the evaluation form, where they were presented with the ten Likert rating scales and two open-text boxes. The experiment had two parts with exactly the same procedure and experimental instructions, but using popular music ("Jailhouse Rock") and classical music (Bruckner's Symphony No. 4) respectively. Immediately after listening to the three recordings of each part, participants filled the final evaluation form consisting in the final comparative rating scales and the open-text box. Between completing the two parts of the experiment participants were asked to fill out the STOMP-R questionnaire. In the nonprestige condition the procedure was the same. Participants were also instructed that they would listen to three different performances of the same piece, but the texts presented with the music did not induce any kind of prestige. The three recordings were presented as Performer 1, Performer 2, and Performer 3. Two weeks after the experiment, participants were asked via email to fill out the BFI, SDS-17, and the 8 items measuring suggestibility. The experiment and questionnaires were implemented in *Qualtrics* software (Qualtrics, Provo, UT). This research was granted ethical approval by the Ethics Committee of the Department of Psychology of Goldsmiths College, University of London.

Results

THE REPEATED RECORDING ILLUSION

In order to determine whether participants fell for the repeated recording illusion or not we used the following procedure: We first assessed the information provided in the open-text boxes. From a total of 14 open-text boxes (7 in the popular music condition and 7 in the classical music conditions), on average participants provided information in 87.35% of the boxes (93.7% in the popular music condition and 93.68% in the classical music condition). By using the information provided in the open-text boxes we were able to identify 48 participants out of 72 (66.67%) in the popular music condition and 50 participants out of 72 (69.45%) in the classical music condition, who provided specific information either reporting differences between performances or reporting that the recordings were the same.

There were cases wherein the information from the open-text boxes was not sufficient to make a clear and objective decision but suggested a direction: either that the participant was not aware that the recordings were identical or that the participant suspected that they were the same. In these cases, we took into consideration the scores from the final comparative rating scales where participants had to compare how much did they like each recording in comparison to the others, on a scale from 0 (much less than the others) to 100 (much more than the others), where the midpoint of the scale ("50") was labeled as *as much as the others*. We only classified the participant when the scores from the final comparative ratings confirmed the suggested direction from the text boxes. It is important to note that we never took into consideration the scores from the final comparative ratings on its own.

When the information from the open-text boxes was not sufficient and/or too ambiguous to make a clear and objective decision, we did not include the participant's data in the subsequent analyses. Two participants provided highly ambiguous statements in the open-text boxes for both music conditions and the two participants were therefore excluded from the subsequent analyses. Furthermore, one participant provided ambiguous information in the popular music condition and a different participant in the classical music condition. Thus, we had a total of 69 participants in each music condition.

As a consequence of using the above mentioned procedure, we had a total of four possible criteria to determine whether participants fell for the repeated recording illusion or not (see Appendix C for a decision diagram depicting the decision procedure and criteria;

The tables in Appendix F and G show the information used to make each individual decision per participant in the two music conditions):

- (1) When the information provided in the open-text boxes specifically indicated any differences between performances: In the popular music condition, 37 out of 69 participants (53.62%) specifically reported information indicating differences between performances, such as “more upbeat than the two others, a happier sounding performance” or “this piece sounds more aggressive than the previous one. The tempo for me is faster.” In the classical music condition, 42 out of 69 participants (60.87%) specifically reported information indicating differences between performances, such as “the mood in this piece seemed to escalate a lot more naturally than in the other pieces” or “this interpretation sounded a bit more hesitant. Again, it was not as dramatic as the first performance, but it was clearer than the second one.”
- (2) When the information in the open-text boxes specifically indicated that the participant realized that the recordings were the same: In the popular music condition, 11 out 69 participants (15.94%) specifically reported information indicating that the recordings were the same (e.g., “I reckon this is the same file repeated three times” or “this is absolutely the same as the first two”). In the classical music condition, 8 out 69 participants (11.59%) specifically reported information indicating that the recordings were the same (e.g., “This sounds exactly like the two others” or “I thought all 3 were the same”).
- (3) When the information provided in the open-text boxes was not sufficient to make a clear and objective decision but suggested that the participant was not aware that the recordings were identical: In these cases, in addition to the open-text boxes, we took into consideration the scores from the final comparative rating scales. If at least one score from the final comparative ratings differed by 10% from the midpoint of the scale (“50”), or any two scores differed by 10% from each other, we considered the participant as falling for the illusion. Nineteen participants (27.54%) in the popular music condition and 17 participants (24.64%) in the classical music condition were classified using this third criterion.
- (4) When the information provided in the open-text boxes was not sufficient to make a clear and objective decision, but suggested that the

TABLE 1. *Numbers of Participants Falling for the Repeated Recording Illusion*

Did participants fall for the repeated recording illusion?	Yes	%	No	%
Total	52	75.36	17	24.64
Popular music	56	81.16	13	18.84
Classical music	59	85.51	10	14.49
Prestige-suggestion group	43	80.70	14	24.56
Nonprestige group	9	75	3	25

Note. Participants were classified as NO if they identified the three recordings as identical in at least one of the two music conditions.

participant suspected that the performances were the same: In these cases, in addition to the open-text boxes, we took into consideration the scores from the final comparative rating scales. If the three scores from the final comparative ratings did not differ more than 10% from the midpoint of the scale (“50”), we considered the participant as not falling for the illusion. Two participants (2.90%) in the popular music condition and two different participants (2.90%) in the classical music condition were classified using this fourth criterion.

Table 1 shows the number of participants who fell for the repeated recording illusion. In the total sample of participants, 52 out of 69 participants (75.36%) believed that they had heard different musical performances in at least one of the two music conditions. By contrast, 17 participants (24.64%) recognized that the performance was the same in at least one of the two music conditions. Only 6 out of 69 participants (8.7%) realized that the recordings were identical in both music conditions. When looking at the music conditions separately, in the popular music condition 56 participants (81.16%) fell for the illusion and 13 participants (18.84%) did not. In the classical music condition, 59 participants (85.51%) fell for the illusion and 10 participants (14.49%) did not. Additionally, in the nonprestige condition (where the effect of explicit information was not manipulated), 9 out of 12 participants (75%) were susceptible to the illusion. According to a X^2 test, there was no significant association between the music conditions (popular and classical piece) and the occurrence of the repeated recording illusion, $X^2(1) = .47$, $p = .49$. According to Fisher’s Exact test, there was no significant association between the presence of prestige (i.e., prestige-suggestion and nonprestige group) and the occurrence of the illusion ($p = .65$).

Generally, participants rated the popular music piece as more familiar ($M = 72.16$, $SD = 21.93$ on 100-point

rating scale) than the classical piece ($M = 13.73$, $SD = 21.10$). This difference in familiarity was highly significant as indicated by a paired samples t -test, $t(68) = 16.43$, $p < .001$.

INDIVIDUAL DIFFERENCE FACTORS

The analysis of individual difference factors was conducted using a data classification method known as the random forest (Breiman, 2001), in which the aim was to examine whether individual differences contributed to the repeated recording illusion. Random forest procedures differ in a number of ways from other classification methods in that they can handle large sets of predictor variables and do not assume a linear relationship between predictors (see Hastie, Tibshirani, & Friedman, 2009; see Pawley & Müllensiefen, 2012, for the use of random forests in music psychology). We used the conditional random forest based on permutation tests as implemented in the R package “party” (Hothorn, Buehlmann, Dudoit, Molinaro, & Van der Laan, 2006; Hothorn, Hornik, & Zeileis, 2006; Strobl, Boulesteix, Kneib, Agustin, & Zeileis, 2008; Strobl, Malley, & Tutz, 2009). The random forest model was run with a size of 5000 trees. We employed a measure of variable importance for each predictor variable, which is designed to produce unbiased estimates of variable importance even in situations where significant correlations between predictor variables exist and when the dependent variable is very unequally distributed (Janitza, Strobl, & Boulesteix, 2013).

As predictor variables, we used 6 demographic variables as well as musical variables that were collected during the experimental session (age, gender, Gold-MSI Musical Training and Active Engagement scores, STOMP preference scores for Reflective & Complex, Intense & Rebellious, Upbeat & Conventional, and Energetic & Rhythmic). Data for 9 additional variables were collected via the follow-up questionnaire measuring the big five personality traits (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness) as well as suggestibility (Authority score, Consensus score, Persuadability score, and Social Desirability score). Using these 17 predictor variables we computed two different models with two different binary dependent variables: (a) a strict criterion model in which only those participants who fell for the illusion in both music conditions were considered as not falling for the illusion, and (b) a less strict criterion model where we considered as not falling for the illusion those participants who fell for the illusion in at least one of the two music conditions. A variable importance score was obtained for each predictor variable, describing how predictive each variable was

compared to the others. We applied a “confidence interval” criterion in order to select the top performing variables. Only the variables whose variable importance scores were positive and greater than the absolute value of the lowest negative variable importance score were selected (Strobl et al., 2008; Strobl et al., 2009).

The two models (strict and less strict criterion) delivered very similar results, indicating that there were two variable importance scores that met the above criterion (*neuroticism* and *openness*). In both models, neuroticism was the most important variable contributing to the repeated recording illusion, followed by openness (see Appendix D for graphs with the 17 variable importance scores in the two models). In the strict criterion model, neuroticism was approximately 3.5 times more important than openness. In this model, those participants falling for the illusion in the two music conditions scored higher in neuroticism ($M = 23.41$, $SD = 5.17$) and openness ($M = 40.12$, $SD = 5.14$) than those participants who did not fall for the illusion ($M = 17.43$, $SD = 6.85$ on the neuroticism factor; $M = 35.28$, $SD = 7.02$ on the openness factor). In the less strict criterion model, neuroticism was approximately 3 times more important than openness. In this model, those participants who fell for the illusion in at least one of the two music conditions scored higher in neuroticism ($M = 23.14$, $SD = 5.55$) and openness ($M = 40.12$, $SD = 5.42$) than those participants who did not fall for the illusion ($M = 17.43$, $SD = 6.85$ on the neuroticism factor; $M = 35.28$, $SD = 7.02$ on the openness factor).

EXTRINSIC FACTORS: THE EFFECTS OF EXPLICIT INFORMATION AND REPEATED EXPOSURE

The subsequent analyses included the sixty participants of the main experimental group (i.e., where we manipulated the effect of explicit information). In the popular music condition, three participants were excluded from the analyses and ten fell for the illusion. Therefore, in the popular music condition we had a total of 47 participants. In the classical music condition, three participants were excluded from the analyses and nine fell for the illusion. Therefore, in the classical music condition we had a total of 48 participants.

Participants' ratings on the ten Likert rating scales were aggregated into a single scale. First, the ratings of each participant on each rating scale were transformed into z -scores across the ratings of all six recordings (three in the popular music condition and three in the classical). Then, a principal component analysis (PCA) was conducted on the z -transformed data of the ten rating scales. The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis, $KMO = .93$

(“marvellous” according to Hutcheson & Sofroniou, 1999). In addition, all KMO values for individual rating scales were greater than .86, which is well above commonly accepted limit of .5 (Field, 2013). The scree plot of the different factor solution was very clear and indicated a solution with just one factor. Moreover, there was only one PCA component with an eigenvalue >1 which explained 64.56% of the variance. Thus, this one-factor PCA solution was accepted and component scores for all participants’ ratings were computed using the regression method.

Because the two music recordings used in the popular and classical music conditions differed substantially in several aspects (i.e., music genre, familiarity, presence of words/ vocalizations, duration of the excerpt, and quality of the recording), we ran two separate models, one with the ratings obtained in the popular music condition and one with the ratings obtained in the classical music condition (see Appendix E for a summary table of both models). In addition, the ratings were standardized separately for each music condition.

To test the hypothesis regarding the effects of explicit information and repeated exposure we used the R packages lme4 (Bates, Mächler, Bolker, & Walker, 2015) and lmerTest (Kuznetsova, Brockhoff, & Christensen, 2016) to perform a linear mixed effects analysis with the z-scores of the participants’ ratings as the dependent variable. In the two models, explicit information (low, medium, and high prestige of the text) and repeated exposure (first, second, and third position) were the fixed effect independent factors, whereas participants were the random effect factor.

The linear mixed-effect model of the popular music condition revealed that there were significant main effects of explicit information ($p < .001$) and repeated exposure ($p < .001$). Because the interaction between explicit information and repeated exposure was not significant we ran the model again only with the two main factors. The effects of explicit information and repeated exposure become visible in Figure 1. The effect of explicit information shows that when the recording was presented with a high prestige text the ratings were significantly higher than when presented with low and medium texts. The effect of repeated exposure of the recording shows that when the recording was heard in the second and third positions the ratings were significantly higher than when heard in the first position.

The linear mixed-effect model of the classical music condition revealed that there was a significant main effect of explicit information ($p < .001$). However, the effect of repeated exposure and the interaction between explicit information and repeated exposure were not

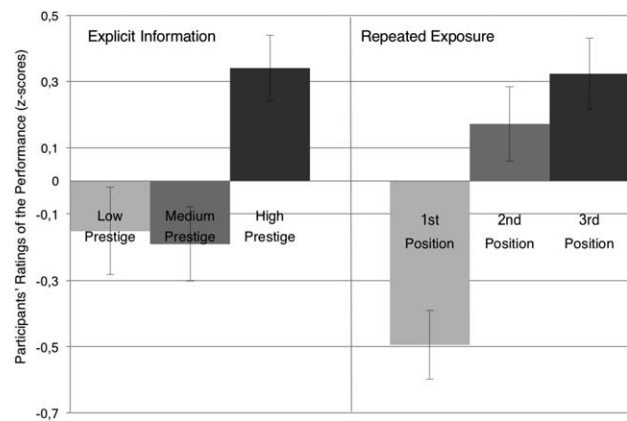


FIGURE 1. Effects of explicit information and repeated exposure in the popular music condition. Error bars represent the standard error.

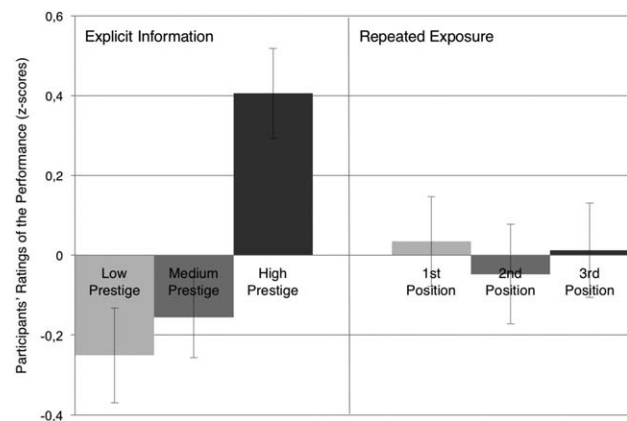


FIGURE 2. Effects of explicit information and repeated exposure in the classical music condition. Error bars represent the standard error.

significant. Because the interaction between explicit information and repeated exposure was not significant we ran the model again only with the two main factors. The effect of explicit information shows that when the recording was presented with a high prestige text the ratings were significantly higher than when presented with low and medium texts (Figure 2).

The R^2 for the classical music model was .16 and therefore lower than the R^2 of .28 of the popular music model, indicating that the extrinsic factors explained more of the variance in the more familiar popular music condition.

EXPLORATORY ANALYSIS (REGRESSION TREE MODEL)

In order to capture higher order interactions between extrinsic and individual difference factors and identify conditions that lead to particularly low and high ratings,

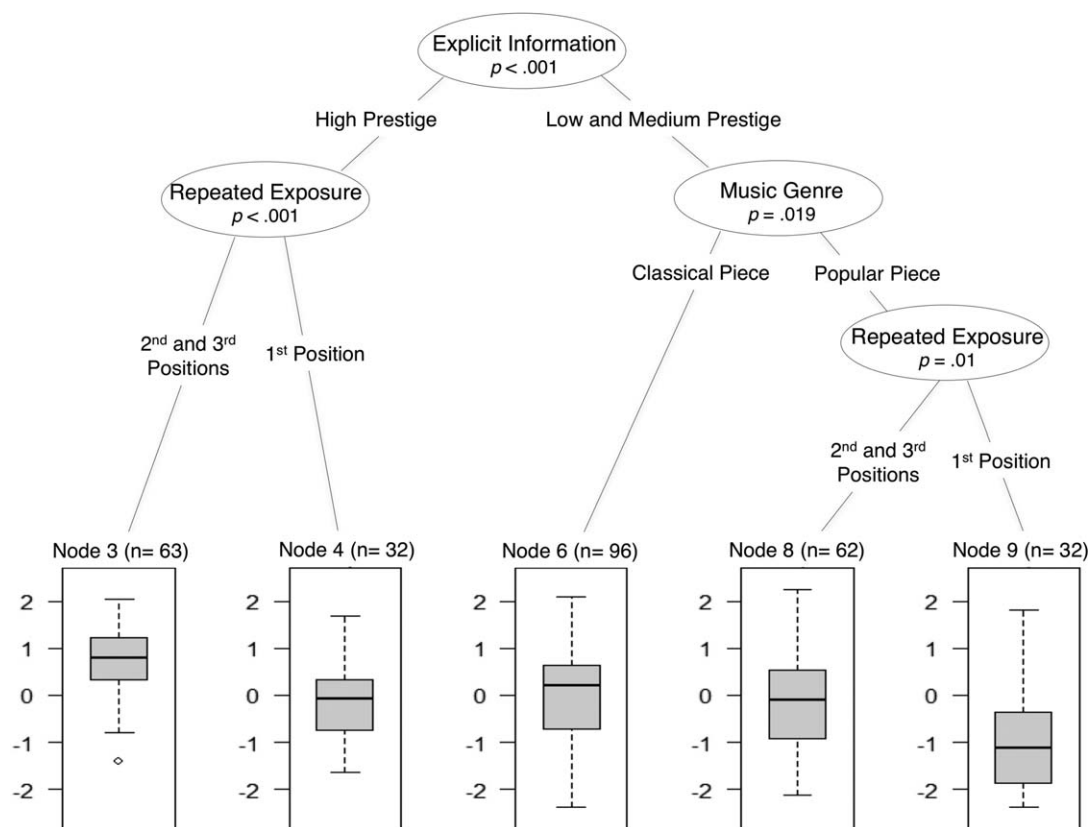


FIGURE 3. Regression tree model.

we computed a regression tree model based on permutation tests as implemented in the R package “party” (Hothorn, Buehlmann et al., 2006; Hothorn, Hornik, & Zeileis, 2006; Strobl et al., 2008, 2009). Statistical tree models differ in a number of ways from linear regression models (see Hastie et al., 2009) in that they use a built-in variable selection mechanism and therefore can handle large sets of predictor variables. In addition, tree models do not assume a linear relationship between predictors and the dependent variable and they are very useful for modelling higher-order interaction effects between predictor variables automatically. For this study we used a particular family of tree models called conditional inference trees that combine the rigorous theory of permutation statistics (Hothorn, Hornik, & Zeileis, 2006) with the principle of recursive partitioning (Zeileis, Hothorn, & Hornik, 2008).

For the regression tree model, the z-transformed participants’ ratings served as the dependent variable. In addition to the two extrinsic factors (explicit information and repeated exposure), we added the factor music genre (popular and classical music) and six individual difference variables (1. music training, 2. self-rated

familiarity with the music piece, 3. preference for the STOMP meta-genre reflective & complex, 4. preference for the STOMP meta-genre Intense & Rebellious, 5. neuroticism, and 6. Openness), resulting in a total of nine independent variables. Figure 3 shows the structure of the regression tree. The model makes use of only 3 of the nine independent variables and has an R^2 value of .23. For each node of the tree, the p values indicating the significance of the split based on the permutation statistics are presented as well as a description of the two subgroups of the split on the independent variable. For the terminal nodes at the bottom of the graph, the distribution of the ratings on the standardized rating scale are depicted as box-and-whisker plots.

The tree model can be interpreted by starting at the top and following each branch down, to arrive at a terminal node. A path to a terminal node describes the interaction of experimental conditions that lead to a particular subset of ratings. To arrive at the subset with the highest (i.e., most positive) average ratings, follow the first “Explicit Information” node down the “High Prestige” branch (left-hand side) and then descend to the left at the “Repeated Exposure” node down the “2nd and

3rd Positions” branch. This branch can be interpreted as follows: when participants listened to the music recording presented with a high prestige text in the second and third positions, the average ratings were around 1 and, therefore, the highest compared to the other terminal branches of the model. In contrast, the lowest ratings, which were around -1, were given when the recording was presented with low and medium prestige texts, in the popular music condition, and when the recording was heard for the first time. Overall, the regression tree model confirms the effects of explicit information and repeated exposure, but it also shows higher-level interactions between the extrinsic factors and the two pieces of music. None of the individual difference factors were significant in the tree model. This indicates that after participants had fallen for the illusion, individual difference factors did not play an important role and musical judgments were mainly influenced by the extrinsic factors.

Discussion

The primary aim of the present study was to construct an experimental paradigm to enable the systematic measurement of the repeated recording illusion. Participants were misled to think that they had heard three different performances of an original piece when in fact they were exposed to the same repeated recording. Each time, the recording was accompanied by a different text suggesting a low, medium, or high prestige of the performer. Most participants (75.36%) believed that they had heard different musical performances. In contrast, seventeen participants (24.64%) recognized that the performance was the same in at least one of the two music conditions. Only six participants (8.7%) realized that the recordings were identical in both music conditions. Nearly three-quarters of the participants provided verbal comments indicating specific differences between the performances (e.g., “this piece sounds more aggressive than the previous one. The tempo for me is faster”) or that they were the same (e.g., “I reckon this is the same file repeated three times”). Thus, it can be concluded that the majority of the participants fell for the repeated recording illusion. This finding suggests that musical judgments are sometimes not based on perceptual features and musical cues but are influenced by factors that do not depend on the music itself. This is at least true when a mild deception is applied and participants believe that they had heard different performances.

It could be argued that the repeated recording illusion occurs in part because participants are not familiar with the original piece of music. We examined the illusion

using two different pieces that were significantly different on familiarity, a highly familiar piece of popular music (“Jailhouse Rock” by Elvis Presley) and a highly unfamiliar piece of classical music (Bruckner’s Symphony No. 4). The repeated recording illusion occurred similarly in the two music conditions. However, these two recordings differed substantially in several other aspects, including music genre, complexity, length of the excerpt, presence of vocals, and quality of the recording. Thus, these variables are confounded in this experimental setup. Any interpretation of differences between the two musical stimuli will have to take this into account. Further studies should explore the repeated recording illusion with a larger range of different performances and recordings.

It is important to note that there is a main methodological restriction to be considered in the experimental design used here: an implicit bias of authority figure. In other words, the fact that participants were told they would listen to “three different performances” by an investigator in a lab situation may account, at least partly, for the occurrence of the illusion. It would be interesting for future research to investigate the repeated recording illusion using an experimental paradigm without any implicit bias of authority. This paradigm could consist in presenting participants with pairs of different and identical musical performances. Participants would be instructed to rate how different are the two performances using several rating scales. In the cases where the performances were identical, participants’ ratings would indicate to what extent people hear differences when listening to the same repeated recording without relying on a judgments bias exerted by a figure of authority.

The second aim of the study was to investigate possible individual difference factors that contribute to the repeated recording illusion. The most important individual difference factor related to the illusion was the personality trait of neuroticism, which is in line with previous research showing a positive (but low) link between vulnerability to suggestion and neuroticism (see Gudjonsson, 2003). This finding suggests that people who tend to be anxious, pessimistic, shy, fearful, vulnerable, and emotionally unstable are more likely to fall for the repeated recording illusion. Although less important, openness to experience also was a significant factor related to the occurrence of the illusion, suggesting that people who tend to be curious, imaginative, artistic, excitable, and unconventional are more likely to fall for the illusion. Importantly, none of the other individual difference factors that were expected to contribute to the illusion were significant, including music training, suggestibility, and preferences for music style.

We consider particularly interesting that different levels of suggestibility (including bias to authority, consensus, persuadability, and social desirability) were not related with the occurrence of the illusion. Moreover, in our sample of participants, highly trained musicians were not any more or any less susceptible to the repeated recording illusion than participants with low levels of music training. Thus, it remains still open the question of which are the main individual differences contributing to the repeated recording illusion. For instance, what would occur when using participants with a greater range of music training and expertise (e.g., top-level professional musicians and music critics)? Would other individual differences (e.g., intelligence, memory, perceptual abilities) be able to explain why some people fall for the illusion while others seem not to be unaffected by it?

The third aim of the present research was to investigate extrinsic factors responsible for differences in musical judgments when the acoustic input remains the same. As predicted, we found that the effect of explicit information contributed significantly to differences in musical judgments. This effect was clear in the two music conditions, where participants rated the same music recording significantly better when presented with a high prestige text than when presented with low and medium prestige texts. This finding is consistent with previous research on the effects of explicit information upon aesthetic reactions to music (e.g., Kroger & Margulis, 2016; Margulis, 2010; Margulis et al., 2015; North & Hargreaves, 2005). Using a similar paradigm, where identical artworks were presented with different contextual explicit information varying in prestige, Kirk et al. (2009) found that prefrontal and orbitofrontal cortices recruited by aesthetic judgments were significantly influenced by the explicit information presented with the same stimuli. We suggest that this neural system could also be responsible for the modulation of aesthetic reactions to music by explicit contextual information.

The effect of repeated exposure was only significant in the more familiar popular music condition, but not in the more unfamiliar classical music condition. This finding supports partly previous research on the effects of repeated exposure to music (North & Hargreaves, 2008, for a review). In one of the few studies using musical performances as stimuli, Kroger and Margulis (2016) found that evaluations of performances were driven by a combination of repeated exposure and the actual identity of the performer. Interestingly, in a second experiment, Kroger and Margulis (2016) found that the effect of explicit information was mitigated by the influence of the actual performer and repeated exposure, showing interplay between intrinsic and extrinsic

factors. In the present study, the two original pieces of music differed in a number of important aspects. For instance, the classical piece was a minute longer than the popular piece, did not contain vocals, and was highly unfamiliar to most of the participants. Furthermore, while the popular music piece was a live recording from 1968 that had a notably worse recording quality than ordinary studio recordings, the quality of the classical music piece (recorded live in 1998) was superior. Therefore, it may be possible that the effect of repeated exposure did not affect participants in the classical music condition because of the nature of the music recording. Moreover, the explicit information presented with the recordings might have had a different impact on participants in the two music conditions. Future studies will need to explore the strength of the effect of repeated exposure across a larger range of different performances and recordings.

In an attempt to explore higher-order interactions between the extrinsic and individual difference factors, we used a regression tree model in which we identified conditions that lead to particularly low and high ratings. The highest ratings were given when the music recording was presented with a high prestige text and heard in the second and third positions. In contrast, the lowest ratings were found when participants listened to the popular music piece in the first position and presented with low and medium prestige texts. Overall, the regression tree model confirmed the effects of explicit information and repeated exposure, but it also showed higher-level interactions between the extrinsic factors and the two pieces of music. None of the individual difference factors used in the model (music training, familiarity with the original piece, music preferences, neuroticism, and openness) were significant in the regression tree model. This finding suggests that after participants had fallen for the illusion, individual difference factors did not play an important role and musical judgments were mainly influenced by the extrinsic factors.

The present study focussed on extrinsic factors in order to examine differences in musical judgments when the acoustic input remains the same. Nevertheless, one could argue that the factors of explicit information and repeated exposure might also be responsible, in part, for the occurrence of the illusion. The results from a nonprestige group, where the effect of explicit information was not manipulated, indicated that 75% participants were susceptible to the illusion. This finding suggests that the effect of explicit information is not essential for the occurrence of the illusion. By contrast, we consider it likely that the effect of repeated exposure

contributes to the illusion. In an extensive investigation of repetition in musical experience, Margulis (2014) provides relevant insights to this matter. She stated that, “[a]t a minimum, a repeated element will sound different from its initial presentation by virtue of coming later and having been heard before” (p. 35). Although in this quote Margulis refers to repetition within individual pieces of music, we find it plausible that the same principle should apply to the repeated recording illusion: while the musical input remains the same, repeated exposure modifies the listening experience, giving rise to the feeling that the performances are different.

Two relevant questions arise from the results of this study. Why are some individuals more susceptible to the illusion than others? One way to approach this question is the study of further individual difference factors (e.g., intelligence, memory, perceptual abilities) that may be associated with the repeated recording illusion. The second question refers to a more fundamental issue: did participants in this study actually perceive differences between the repetitions of the same recording? Or, alternatively, did they believe they heard differences because they were misled to think so? We encourage the use of neuroimaging techniques as one possible approach to investigate whether the illusion is a perceptual phenomenon or rather a bias in a secondary and later stage of cognitive processing and decision-making.

Taking a wider perspective, the research framework developed by Tversky and Kahneman (Kahneman & Tversky, 1984; Tversky & Kahneman, 1974; see Kahneman, 2011, for a review) could provide a theoretical framework by which the results of the current study could be interpreted. Although it does not involve music and is mainly concerned with economic decision processes, Tversky and Kahneman’s framework offers insight into how to investigate traditional psychological biases in musical judgments by using recent research on human judgments and decision-making. However, this framework has not yet been applied explicitly to the study of evaluative judgment processes involving music.

The effect of explicit information may fall within a broad heuristic principle, namely, the affect heuristic (Kahneman & Frederick, 2002; Slovic, Finucane, Peters, & MacGregor, 2002), which refers to the reliance on good or bad feelings experienced in relation to a stimulus. Thus, if the emotions associated with a stimulus are positive, people will be more likely to judge characteristics of the pertinent stimulus more positively, as found in the present study when the music recording was presented with a high prestige text. Similarly, the effect of repeated exposure is one of several mechanisms within the bias of perceptual fluency (see Kahneman,

2011, for a review), which has been widely shown to influence human judgments and decision-making in many areas (see Reber, Schwarz, & Winkielman, 2004, for a review). Such findings suggest that perceptual fluency gives rise to feelings of familiarity and a positive affective response that results in an increase in preference judgments. In the present study, this is evident only when participants listened to the more familiar popular music recording.

Our results suggest that at least in certain situations, evaluations of music rely on judgment biases and heuristics that do not depend on the stimuli themselves, which is in line with models of decision-making and the research framework developed by Tversky and Kahneman. However, when applying Tversky and Kahneman’s framework to the study of evaluative and judgment processes involving music, one should consider the implications and difficulties of using music as stimuli (e.g., familiarity, complexity, presence of vocals, individual preferences to music, personality). This approach wherein biases in musical judgments are linked to comparable research in behavioral economics could be used to investigate and better understand musical judgments, preferences, and choice behavior. This general approach, that could be termed *the behavioral economics of music*, would attempt to create a solid understating of the role that behavioral economics can play in the study of musical judgments and preferences, two fields that have been surprisingly unconnected in the literature so far.

In summary, the findings of the present study show that most participants believed that they had heard different musical performances when in fact they were identical. This illusion occurred regardless of participants’ levels of suggestibility, music training, and preferences for music style. However, high levels on the personality traits of neuroticism and openness made it significantly more likely that an individual would fall for the illusion. While the explicit information presented with the music influenced participants’ evaluations of music significantly, the effect of repeated exposure affected participants’ ratings only in the more familiar popular music recording. These findings support previous research showing that musical judgments are sometimes not based on musical cues and features but are influenced by factors that do not depend on the music itself. Beyond the findings and limitations of the present research, the repeated recording illusion can constitute a useful paradigm for investigating psychological biases and individual differences in aesthetic and musical judgments because the illusion allows for the study of their effects while the music remains the same.

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Appendix A

Prestige Texts (Low, Medium, and High) Used in the Popular Music Condition (“Jailhouse Rock” by Elvis Presley)

Popular Music Condition: Low Prestige Text – Larry Leigh

Larry Leigh was a humble truck driver who developed an obsessive love for Elvis Presley from an early age. His lack of musical training did not hold him back from impersonating his beloved star on stage.

Although Leigh participated in *the Georgia Elvis Festival* and *the ETA Preliminary Competition*, he never succeeded in his career as an Elvis imitator and his critics labelled him as an amateur singer.

Leigh had some similarities to Elvis’ voice, however, due to the lack of success he gave up his dream. A close friend expressed that his unsuccessful career as an Elvis impersonator made him spiral into a deep depression.

Information source: Impersonators in America (2001) by Esther Newton

Popular Music Condition: Medium Prestige Text – Drew Polsun

Drew Polsun was not just an owner of a music record store, but also a lifelong lover and impersonator of Elvis. With some musical training from an early age, he began to perform as Elvis in his local area.

Putting his business on hold he began to compete more seriously in Elvis impersonator contests. At *the Ultimate Elvis Tribute Artist Contest* he placed 17th out of roughly 40 impersonators.

Never able to reach the top, he turned back to his business at the music store and focused on his family. Still to this day, he continues to perform in his hometown sharing his love for the King.

Information source: Impersonating Elvis (2009) by Leslie Rubinkowski

Popular Music Condition: High Prestige Text – Shawn Klush

Starting at the age of 6, Shawn Klush would sing and dance like Elvis. He now works as a professional actor and entertainer, and has a strong musical background, from classical to jazz music, in singing and guitar.

Klush became very successful as one of the top Elvis impersonators. He released 3 CDs, became the grand champion at the \$150,000 *World Elvis Tribute Artist Competition*, and received the Heart of the Kind, *World-wide Ambassador of Elvis Award*.

In 2007, he was named the *World’s Greatest Elvis* by 6.5 million international viewers on BBC1 Television in the United Kingdom. Since then, Klush is considered one of the world’s most professional Elvis Tribute Artists.

Information source: www.shawnklush.com

Appendix B

Prestige Texts (Low, Medium, and High) used in the Classical Music Condition (Bruckner Symphony No. 4)

Classical Music Condition: Low Prestige Text – Kurt Schlichter

With an undergraduate degree from Royal Holloway, University of London, Kurt Schlichter, continued his education as a Masters student in conducting at the Royal College of Music.

As a young student, Kurt found it quite challenging to conduct a broad range of classical works in real-life rehearsal and performance situations. But these experiences allowed him to grow and become one of the top students in his class.

Talking to Kurt about his experiences he says, “The opportunities at the Royal College have been highly varied and rewarding. For my final project I was able to conduct one of my favourite Bruckner pieces which allowed me to engage fully with the complex compositional style of this genius composer”.

Information source: www.rcm.ac.uk/conducting/story/kurt

Classical Music Condition: Medium Prestige Text – Pablo Giménez

As the principal conductor of the Royal Seville Symphony Orchestra, Pablo Giménez, put Spain on the map as a place for beautiful interpretations of classical music. Based in Seville, his orchestra has played some very well know interpretations of classical favourites.

Gimenez had become an up-and-coming conductor, performing *Carmen* at the *Liceu’s theatre* of Barcelona and international concert halls in China and Australia.

His album of *Zarzuela* has been released throughout Europe, but did not receive any awards.

Even though his interpretations of works by Brahms and Handel have been regarded as “beautiful orchestral performances”, his interpretations of Beethoven and Wagner were labelled as “lifeless and inexpressive” by some reviewers.

Information source: Guide to Spanish Conductors (2010) by Jose Luis-Garcia

Classical Music Condition: High Prestige Text – Claudio Abbado

Claudio Abbado was widely considered one of the greatest conductors of the 20th century. He served as principal conductor of the Berlin Philharmonic and London

Symphony Orchestra, one of the best ensembles in the world.

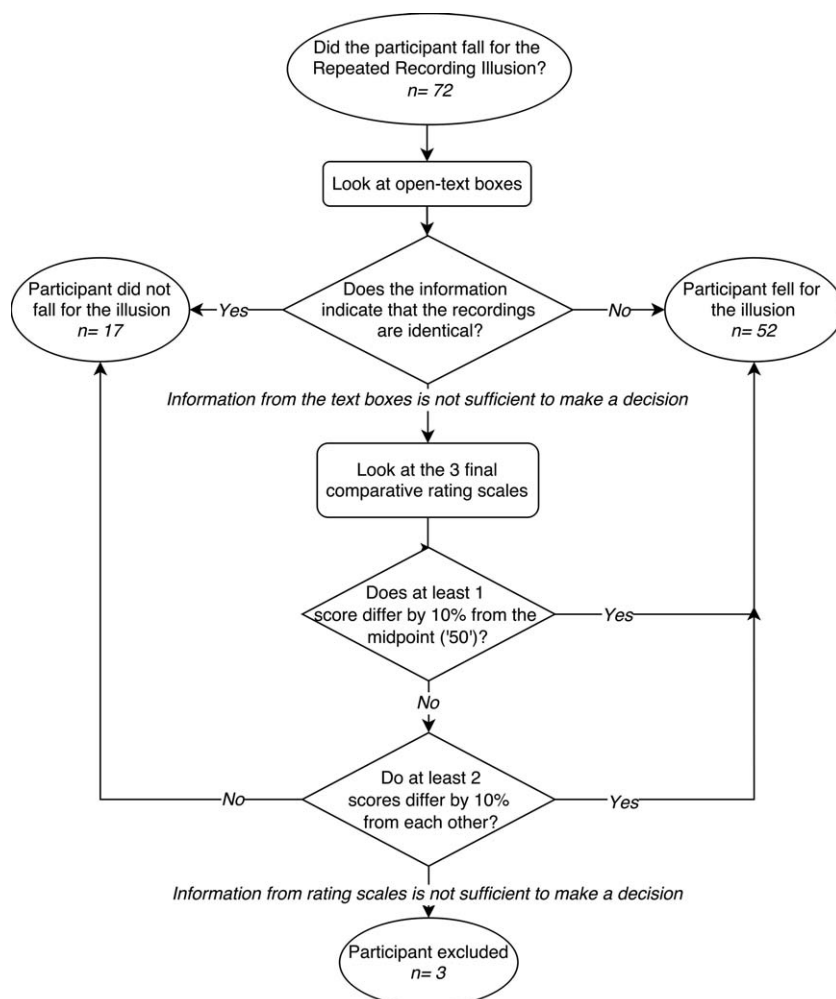
Claudio’s career couldn’t be more successful. He won the International Competition for Composers and the Grammy Award in the Best Small Ensemble Performance. Additionally, the Orchestra Academy of the Berlin Philharmonic established the Claudio Abbado Composition Prize in his honour.

In 2004, Abbado conducted the Berlin Philharmonic to performed Bruckner’s Symphony No. 4 in a series of recorded live concerts. The resulting CD won Best Orchestral Recording of the Year in *Gramophone* awards.

Information source: Stories of the Great Contemporary Conductors (2012) by Maurice Hinson

Appendix C

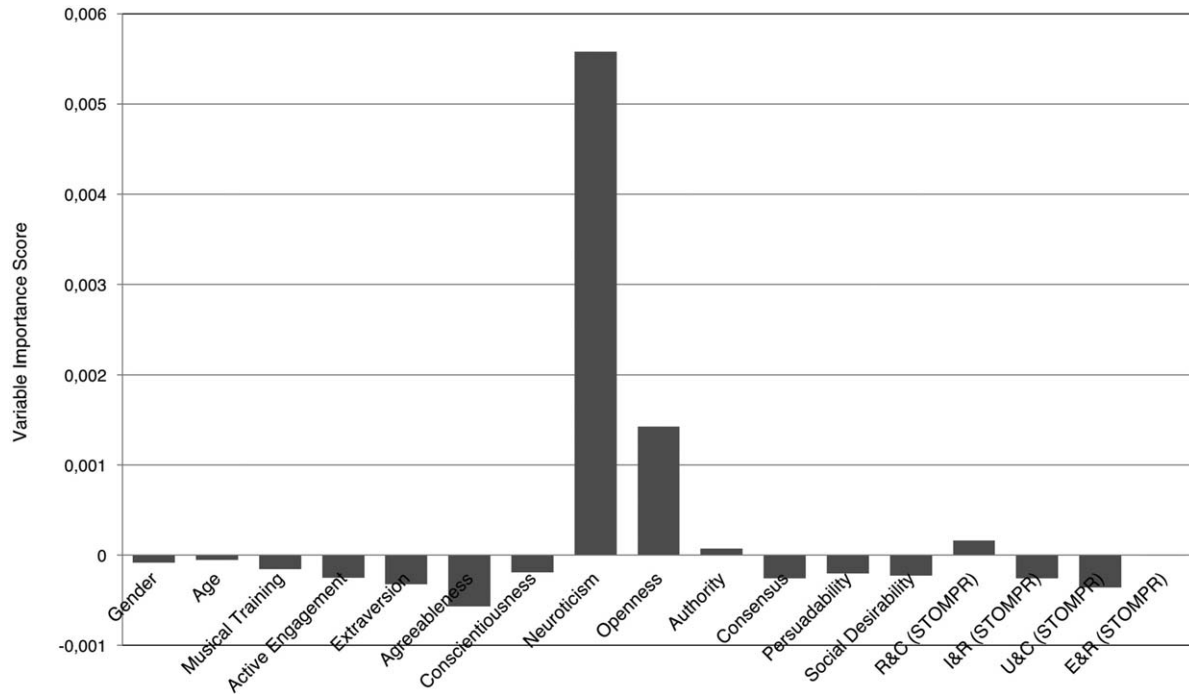
Decision Diagram of the Procedure used to Determine Whether Participants Fell for the Repeated Recording Illusion



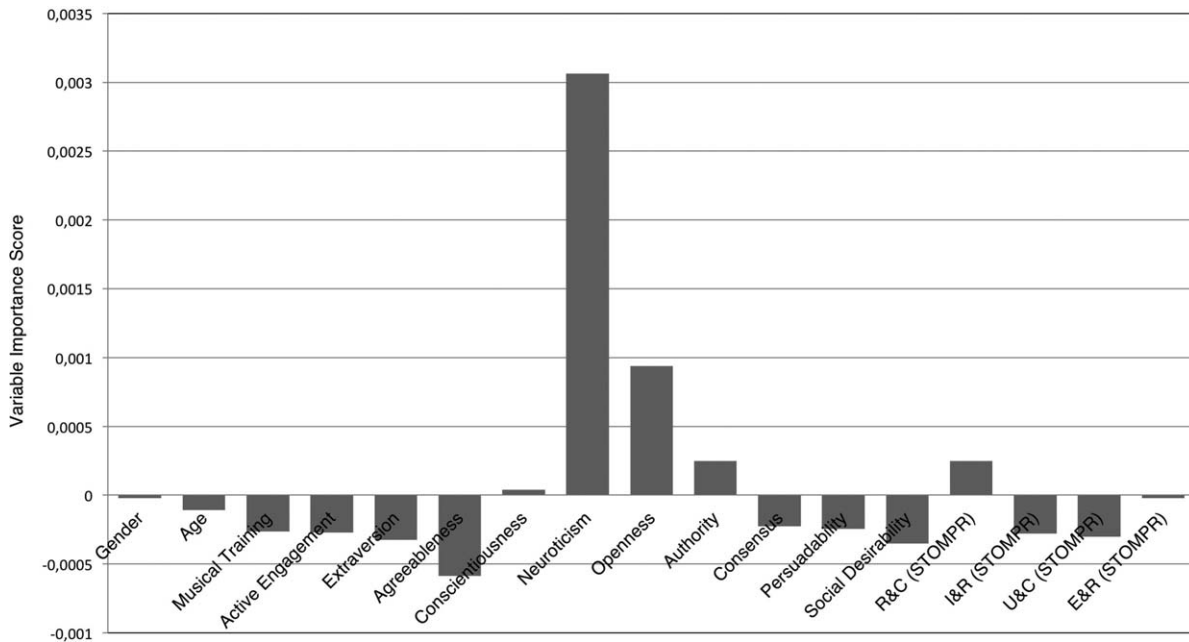
Appendix D

Variable Importance Scores for the 17 Variables

Variable Importance Scores for Predictor Variables in Random Forest Model using Strict Criterion (i.e., Participants Falling for the Illusion in Both Music Conditions)



Variable Importance Scores for Predictor Variables in Random Forest Model using Less Strict Criterion (i.e., Participants Falling for the Illusion in One Music Condition)



Appendix E

Summary Tables of the Two Linear Mixed-Effects Models (Popular Music and Classical Music)

Popular Music Condition

	Sum of Squares	df	F	p value
Explicit Information (EI)	7.89	2	7.79	< .001***
Repeated Exposure (RE)	17.42	2	17.20	< .001***
CI * RE	1.34	4	.66	.62

Classical Music Condition

	Sum of Squares	df	F	p value
Explicit Information (EI)	12.61	2	10.66	< .001***
Repeated Exposure (RE)	.23	2	.19	.82
CI * RE	3.96	4	1.67	.16

Appendix F

Criteria and Information Used to Determine Whether Participants Fell for the Repeated Recording Illusion in the Popular Music Condition

Legend:

Decision.

Yes - Participant is considered as falling for the illusion.

No - Participant is not considered as falling for the illusion.

Why? - Justification of the decision made:

- **A** (*when decision = yes*): The information from the open-text boxes indicates specifically any differences between performances.
- **B** (*when decision = yes*): The information from the open-text boxes is not sufficient but suggests that the participant was not aware that the recordings were identical. In addition, at least one score from the final comparative rating scales differ by 10% from the midpoint of the scale ('50'), or any two scores differ by 10% from each other.
- **C** (*when decision = no*): The information from the open-text boxes indicates specifically that the participant realized that the recordings were the same.
- **D** (*when decision = no*): The information from the open-text boxes is not sufficient but suggests that the participant suspected that the performances were the same. In addition, none of the three scores from the final comparative rating scales differ more than 10% from the midpoint of the scale ('50').
- **Eliminated:** The information from the open-text boxes and final comparative rating scales are not enough and/ or too ambiguous to make a clear objective decision based on the above criteria.

N°	Information from open-text boxes	Comparative ratings (when needed)			Decision	Why?
1	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	55	75	35	YES	B
2	<i>"some parts sounded a bit too fast compared to the previous version"</i>	–	–	–	YES	A
3	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	25	75	40	YES	B
4	<i>"I have a feeling that it was the same song as before"</i>	–	–	–	NO	C
5	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	74	70	35	YES	B
6	<i>"I think that in this case, the music invites more to move. The voice is deeper and maybe rougher"/ "Yes I did. The voice was more similar to the original song and I like it." vs. "In this case apart that the voice was quite different to the original one. The drums seemed to be quieter than in the original version."</i>	–	–	–	YES	A
7	<i>"the sound quality was much better and the tambourine was much more prominent"/ "I enjoyed this performance much more than the first as it was more upbeat"</i>	–	–	–	YES	A
8	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	61	42	85	YES	B
9	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	81	35	66	YES	B

(continued)

Appendix F. (continued)

N°	Information from open-text boxes	Comparative ratings (when needed)			Decision	Why?
10	"I thought this version sounded more like the original by Elvis sounds like"/ "I enjoyed this performance of the song more than the first one"	–	–	–	YES	A
11	"To me, this interpretation was not as emotionally charged"/ "I found Polsun's voice to sound quite strained and raspy and not as melodic and smooth as the original version"	–	–	–	YES	A
12	"the emotion put into the song seemed to have a personal quality and was sung with more affection"/ "whilst maybe technically better this version [...] seemed to be expressed in lines with less emotion and more inclination to mimic Elvis"	–	–	–	YES	A
13	"Would be money it's all the same tune"	–	–	–	NO	C
14	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	62	79	59	YES	B
15	"perhaps the band was not as good as the in the last one i.e., the second" / "It was helped by the good supporting band, who were better in quality to the band playing in the first piece. He lack a little more in passion than the first one, so while it was perhaps technically better, it could have had a little more emotion"	–	–	–	YES	A
16	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	40	50	60	YES	B
17	"I didn't feel that the instrumentation was quite as tight in this clip, however, with the bass being looser and the piano not as prominent"	–	–	–	YES	A
18	"Still an enjoyable clip, this singer did his best to inject the passion and colour into Jailhouse Rock as Elvis"/ "it was easier to hear the different instruments within the band, including piano and sax, and the band were very tight"	–	–	–	YES	A
19	<i>It cannot be determined whether the participant fell or not for the illusion, but it seems that he/she suspected that the recordings were the same: "Was it the same as the last performer?"</i>	50	50	50	NO	D
20	"with this one (singer) I must say is even higher"/ "I really enjoyed his interpretation probably because his voice was more accurate to Elvis's"	–	–	–	YES	A
21	"The vocal quality of the interpretation wasn't as good for this one"/ "I didn't enjoy this performance as much as the others, mainly due to his vocal quality"/ "This version had much more energy than the previous one and it felt that the performer was having much more fun"	–	–	–	YES	A
22	"I enjoyed it because it seemed more fun and playful in a way. Possibly I was also more friendly minded towards this guy after learning about his tragic history"	–	–	–	YES	A
23	"I have been able to rate easily each interpretation"/ "The voice of the singer is very poor, he can't get a good imitation" vs. "The singer has made a wonderful performance"	–	–	–	YES	A
24	"Larry Leigh's performance reminded me of Polsun's. When I heard Klush's performance I realized that it was the same as the previous one"	–	–	–	NO	C
25	<i>Information is not enough and/or ambiguous</i>	–	–	–	Eliminated	
26	"I'm starting to suspect these are all the same version!!"	–	–	–	NO	C
27	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	74	44	24	YES	B
28	"It is a little difficult to judge which one I preferred the most since they are the exact same clip"	–	–	–	NO	C
29	"Although perhaps not as melodically varied, the singer's tone and timbre was very similar to the original, and really good to listen to"/ "the rhythm section was fairly average" vs. "The tempo felt almost exactly right (perhaps marginally too fast?), and the rhythm section was really strong"	–	–	–	YES	A
30	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	44	85	50	YES	B
31	"I thought the little vocal impros he threw in were what made him slightly better"	–	–	–	YES	A
32	"This performance of 'Jailhouse' is the closest to the original [...] Aurally, the performance sounds more professional"	–	–	–	YES	A
33	"it seemed to me that each performance was the same one performance, which thereby made it difficult to 'interpret' each of the them"	–	–	–	NO	C

(continued)

Appendix F. (continued)

N°	Information from open-text boxes	Comparative ratings (when needed)			Decision	Why?
34	"the vocals were not as professional as on the other two performances"/ "A more passionate performance. It was definitely more rock'n'roll than the previous performance"	–	–	–	YES	A
35	"seemed more in sync with the band and with the audience than the previous performance"/ "I liked this performance because he spent more time on his words than the previous performance, and sounds more confident than the last"	–	–	–	YES	A
36	"I reckon this is the same file repeated three times. The instrumentation is identical, the vocal timbres are the same and even the crowd is the same. I'm fairly certain it's the same person".	–	–	–	NO	C
37	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical.</i>	100	90	53	YES	B
38	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical.</i>	60	55	70	YES	B
39	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical.</i>	59	61	60	YES	B
40	"I enjoyed the overall performance and thought the singer did a pretty decent job" vs. "I did not really enjoy the version. I did not like the vocals - sounded too forced and tuning issues seemed to jar a little"	–	–	–	YES	A
41	"Rhythm was better here, helped by the more relaxed tempo"/ "This was my favourite by far. The vocal performance wasn't monotonous, like the other ones"	–	–	–	YES	A
42	"More upbeat than the two others, a happier sounding performance"/ "Liked it the best of the three, the voice of the singer sounded "cleaner" than the other two"	–	–	–	YES	A
43	<i>It cannot be determined whether the participant fell or not for the illusion, but it seems that he/she suspected that the recordings were the same: "The three versions sounded incredibly similar to me"</i>	50	50	50	NO	D
44	"I like this one a bit better than the two previous ones, even though again it was pretty similar. I just liked the guys voice more"	–	–	–	YES	A
45	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	79	83	71	YES	B
46	<i>Information is not enough and/or ambiguous</i>	–	–	–	Eliminated	
47	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	10	53	61	YES	B
48	"Similar mood as with the previous two, but I didn't like his interpretation that much"	–	–	–	YES	A
49	"I thought it was a decent cover of the original song, but the singers voice although fairly good, was the weakest element"/ "I thought the performance was okay, again the vocalist and the quality of the recording made me rate it slightly lower" vs. "I thought the performance was really led and pushed forward by the vocalist which gave it a good sense of movement and energy"/ "I did enjoy the performance of the song, I liked the quality of the singers voice as I thought it was strong, and fairly accurate to Elvis"	–	–	–	YES	A
50	"I believe that the songs were very similar and difficult to distinguish one from the other. At some point I believed that I was listening at the same song all along."	–	–	–	NO	C
51	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	80	60	30	YES	B
52	"I think this one was far more true to the original than the others"/ "The three interpretation were different but did not vary that much"	–	–	–	YES	A
53	"I am not a big fan of interpretations unless they do something original, and neither of these did. Despite that, I could tell the qualitative difference"	–	–	–	YES	A
54	"I feel like he was shouting rather than singing, so this overall wasn't enjoyable to me musically"/ "This was definitely my favorite because of his energy and vocal dynamics"	–	–	–	YES	A
55	<i>Information is not enough and/or ambiguous</i>	–	–	–	Eliminated	
56	"The singer couldn't quite control his voice as Elvis could, yet there was an emotion in it" vs. "His voice had the gravelly quality of Elvis's. The instrumentation was more taught too"/ "altogether it was smoother which I don't think was necessarily a good thing"	–	–	–	YES	A

(continued)

Appendix F. (continued)

N°	Information from open-text boxes	Comparative ratings (when needed)			Decision	Why?
57	"Closest of the three to the original 'Elvis feeling' in terms of voice." / "It's still a cover. It was closer to the original than the one before"	–	–	–	YES	A
58	"But, I think this one that the tempo is better than the last one" / "I think this one is the best of the three interpretations"	–	–	–	YES	A
59	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	25	57	97	YES	B
60	"For this piece I feel more lively and more energetic. The voice of the singer is quite affective to me." vs "For me the singer's voice is too tender, and in some part I cannot feel the lively spirit from the music"	–	–	–	YES	A
61	"This version has been the best of the three songs that I listened" / "For me, the three songs are a good interpretation of the Elvis original song's"	–	–	–	YES	A
62	"I don't like the tone and rhythm that much" / "yes but the others were better"	–	–	–	YES	A
63	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	57	55	65	YES	B
64	"I liked this performance because the energy of the song was more consistent from the outset. His voice sounded more naturally husky than shouty" / "The performance felt a little bit flatter/less exciting"	–	–	–	YES	A
65	"the overall mood was less fun than in the two previous recordings / music was less vibrant and I didn't receive the disco feeling as in the performance 2 / not catchy enough"	–	–	–	YES	A
66	"I did not exactly enjoy this performance as the singer, at least to my mind, tried too much to sound like Elvis" vs. "I enjoyed this performance. The vocal quality of the singer reminded me strongly of Elvis"	–	–	–	YES	B
67	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	82	24	66	YES	B
68	"this was the least accurate performance, but the emotional impact was really good"	–	–	–	YES	A
69	"this is absolutely the same as the first two"	–	–	–	NO	C
70	"I like this one most. The singer interpretation was better" / "This is my favorite interpretation. The singer had a lot of emotion and the tempo was perfect for me."	–	–	–	YES	A
71	"I honestly couldn't distinguish any noticeable difference between this recording and the last one - it sounded the same"	–	–	–	NO	C
72	"Same performance as last time"	–	–	–	NO	C

Appendix G

Criteria and Information Used to Determine Whether Participants Fell for the Repeated Recording Illusion in the Popular Music Condition

Legend:

Decision.

Yes - Participant is considered as falling for the illusion.

No - Participant is not considered as falling for the illusion.

Why? - Justification of the decision made:

- **A** (*when decision = yes*): The information from the open-text boxes indicates specifically any differences between performances.
- **B** (*when decision = yes*): The information from the open-text boxes is not sufficient but suggests that the participant was not aware that the recordings

were identical. In addition, at least one score from the final comparative rating scales differ by 10% from the midpoint of the scale ('50'), or any two scores differ by 10% from each other.

- **C** (*when decision = no*): The information from the open-text boxes indicates specifically that the participant realized that the recordings were the same.
- **D** (*when decision = no*): The information from the open-text boxes is not sufficient but suggests that the participant suspected that the performances were the same. In addition, none of the three scores from the final comparative rating scales differ more than 10% from the midpoint of the scale ('50').
- **Eliminated**: The information from the open-text boxes and final comparative rating scales are not enough and/ or too ambiguous to make a clear objective decision based on the above criteria.

N°	Information from open-text boxes	Final comparative rating			Decision	Why?
1	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	80	60	35	YES	B
2	"I was the same with the two other ones"/ "It all was the same for me"	–	–	–	NO	C
3	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	75	25	0	YES	B
4	"I liked it, more unity than Pablo's version (winds)"/ "Liked the version, mostly the strings (compared to the others)"	–	–	–	YES	A
5	"I could only feel something more with Schlichter's songs, I don't know why but it probably made more emotional impact than the others"	–	–	–	YES	A
6	"It was much more emotional. The piece was cleaner and synchronized"/ "I enjoyed this performance of the song the most."/ "Again it did not give me the spark that the second one gave. In this case you could notice the synchronization was not perfect."	–	–	–	YES	A
7	"I felt the mood of this piece was much more positive than the last"/ "I thought this performance was the most beautiful. It seemed softer and the sound quality was very good"	–	–	–	YES	A
8	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	72	20	94	YES	B
9	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	25	42	97	YES	B
10	"I enjoyed this performance, but not as much as the performance by Claudio Abbado"/ "For some reason, the tone and key at times sounded different (more major, less minor)"	–	–	–	YES	A
11	"This interpretation of the piece felt a bit more rushed to me than the other two. I felt that this version didn't have the same dramatic pauses as the other two"	–	–	–	YES	A
12	"Initially I felt the intro to this piece had a lack of emotion - in comparison to the previous piece - there seemed to be flatness to the work"	–	–	–	YES	A
13	"Would be money that they are all the same recording"	–	–	–	NO	C
14	"I did not find this song as good as the previous interpretation."	–	–	–	YES	A
15	"I preferred it to the first piece, as I felt that the emotional current of the piece moved a bit quicker"/ "perhaps it was a little quicker in tempo, perhaps a little too rushed at times"	–	–	–	YES	A
16	"not as deep and compacted to the previous one"	–	–	–	YES	A
17	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	30	70	80	YES	B
18	"it perhaps didn't reach the same levels of quiet nearer the beginning as other interpretations did to contrast with the loud ending"	–	–	–	YES	A
19	<i>It cannot be determined whether the participant fell or not for the illusion, but it seems that he/she suspected that the recordings were the same: "were they all the same? if not then they were very similar"</i>	50	50	50	NO	D
20	"With this interpretation of the song I get the feeling that the first one was too slow and the second one too fast and this one the perfect tempo and pace. I liked it the most"	–	–	–	YES	A
21	"The mood in this piece seemed escalate a lot more naturally than in the other pieces"	–	–	–	YES	A
22	"Didn't feel as strong as the last one"/ "I could really find anything I disliked in this one"	–	–	–	YES	A
23	"Rating a orchestra has been much more difficult than rating a vocal song. Despite of this, I have realize about the differences between each interpretations with quite facility"	–	–	–	YES	A
24	"I could see only very little, slight differences between the different interpretations"	–	–	–	YES	A
25	"Exactly the same as the one prior. I can't differentiate between the two"/ "Exactly the same as the previous two."	–	–	–	NO	C
26	"The instruments felt more like they were competing than cooperating in the crescendo at the end, giving it a more frantic feel. I noticed the brass more than the timpani" vs. "This had the sense of building towards something big from early on"	–	–	–	YES	A
27	"I enjoyed this one the best. The trumpets and brass at the end didn't beat me in the face but rather sounded more like a ray of sunlight through clouds on a rainy day"	–	–	–	YES	A

(continued)

Appendix G. (continued)

N°	Information from open-text boxes	Final comparative rating			Decision	Why?
28	"Again, it's hard to place an order of which clip I liked the most since it was the same clip played three times"	–	–	–	NO	C
29	"I enjoyed the performance of the song, and the interpretation was merely different in it's dynamics and style"	–	–	–	YES	A
30	"I've enjoyed Abbado's piece because it's strong and with a lot of personality [...] Anyway, I like the performance because even being a bit more chaotic than the Burke performance it has more variety of instruments in each family"	–	–	–	YES	A
31	"For me, this interpretation was slightly faster than the others, something which I found that I enjoyed more than in the other interpretations. The build was faster and more dramatic"	–	–	–	YES	A
32	"I enjoyed the arrangement more so in this performance, the instruments were in harmony and the piece seemed tighter"/"The performance was cathartic and extremely captivating. I can tell it's a younger interpretation of an older work, the sound feels fresher"	–	–	–	YES	A
33	<i>Information is not enough and/or ambiguous</i>	–	–	–	Eliminated	
34	"This interpretation sounded a bit more hesitant. / Again, it was not as dramatic as the first performance, but it was clearer than the second one. /Maybe this conductor is a lot younger than the previous ones"	–	–	–	YES	A
35	"I thought all 3 were the same"	–	–	–	NO	C
36	"Some of the timing was slightly scrappier and the and the dynamics were less varied. Brass section were very present, as were violins." vs. "It felt like this performance was a bit more mechanical and less emotional"/ "I enjoyed it, but it lacked the fluidity of the Berlin version."	–	–	–	YES	A
37	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	83	95	100	YES	B
38	"I know I enjoyed the first one a lot more than the other two"/ "The song is beautiful but I can't help but feel like this particular performance was not as emotive as it could have been"	–	–	–	YES	A
39	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	78	90	67	YES	B
40	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	40	60	59	YES	B
41	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	57	36	95	YES	B
42	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	60	32	84	YES	B
43	<i>It cannot be determined whether the participant fell or not for the illusion, but it seems that he/she suspected that the recordings were the same: "Again, I found each version to be incredibly similar, so found it difficult to distinguish aspects"</i>	53	54	52	NO	D
44	"This sounds exactly like the two others"	–	–	–	NO	C
45	"It felt like more drama and more action, it also felt a bit fast"/ "I don't know why, but I liked the middle on best"	–	–	–	YES	A
46	<i>Information is not enough and/or ambiguous</i>	–	–	–	Eliminated	
47	"I enjoyed it, although it wasn't my favourite interpretation. I felt it was a little 'darker' in tone colour/timbre and felt that the dynamics and tempo could have been more dramatic"	–	–	–	YES	A
48	"stimulates strong and deep feelings, perhaps more spiritual, and contemplation"/ "I liked it slightly better than the previous one"	–	–	–	YES	A
49	"The performance had some weak elements, the overall balance of the recording had some inadequacies"/ "The performance was ok" vs. "I thought the performance was strong and there was a good tonal quality to the instruments and natural balance between them"/ "I liked the performance of the song, I think it was performed well and it had an effective emotional impact"	–	–	–	YES	A
50	"I still think that is the same song interpreted by the same person all along."	–	–	–	NO	C

(continued)

Appendix G. (continued)

N°	Information from open-text boxes	Final comparative rating			Decision	Why?
51	"This interpretation felt much more agitated throughout, as a result of the faster tempo"/ "Though less 'brassy' (as compared to the Seville Orchestra), this lowered the intensity a little bit."	–	–	–	YES	A
52	"I didn't quite enjoy this performance as much as the last one. Where Gimenez version was determined and executed with clear intentions of the mood it wanted to set, swelling with emotional intensity, Schlichter's execution lacked purpose"/ "Potentially the most professionally executed. However, I feel like it lacked emotion compared to Gimenez"	–	–	–	YES	A
53	"This had so many layers, I would say a great deal of details in the dynamic"/ "It was like this one had more details than the first one"/ "It kind of felt like it was longer"	–	–	–	YES	A
54	"The mood in this one was more anxious rather than emotionally empowering. I felt that the increased volume and intensity made me nervous, which I didn't like that much" vs. "This was an emotional interpretation, which pure feeling behind the entire piece"	–	–	–	YES	A
55	<i>Information is not enough and/or ambiguous</i>	–	–	–	Eliminated YES	A
56	"It seemed more tame than the other versions"/ "some were more emotional than others"/ "I'm not quite so sure what to look for, but some were more emotional than others."	–	–	–		
57	"I can't say what the difference is, but I liked this a little better than the other ones"/ "I think it made me less nervous. There was less of the war"	–	–	–	YES	A
58	"I think this one make me feel the key is not really clear"/ "I think this final part of this one is good ending"	–	–	–	YES	A
59	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	28	0	49	YES	B
60	"This piece sounds more aggressive than the previous one. The tempo for me is faster"	–	–	–	YES	A
61	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	8	49	70	YES	B
62	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	29	59	85	YES	B
63	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	59	47	63	YES	B
64	"I enjoyed this performance because it felt like a smoother performance than the last. And the final note wasn't as harsh so it felt like a more natural conclusion"	–	–	–	YES	A
65	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	77	50	40	YES	B
66	"I feel completely neutral about this performance. It was neither uplifting or depressing" vs. "It was an enjoyable piece of music, though I can not explain why"	–	–	–	YES	A
67	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	73	65	82	YES	B
68	<i>Information not sufficient but seems to indicate that the participant was not aware that the recordings were identical</i>	100	0	48	YES	B
69	"I preferred this one much more than the last. I thought that the tone qualities of the soprano voices were better balanced, which really made the brass sound more effortless"	–	–	–	YES	A
70	"I enjoyed but not as much as the others. I felt that there was no emotion on the beginning of the song"	–	–	–	YES	A
71	"Although I preferred performance 1, I enjoyed all of the performances to some extent because I felt that, in many ways, each conductor made similar decisions, such as the choice of tempo and dynamic range"/ "this one felt a bit more"	–	–	–	YES	A
72	"It is the exact same interpretation"/ "Same as the last interpretation"	–	–	–	NO	C