The Effect of Repetition and Expertise on Liking and Complexity in Contemporary Music

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ABSTRACT

Aesthetic perception of music has been extensively researched in the last decades. Numerous studies suggest that listeners find a piece of music more or less pleasant according to its complexity. Experimental results show that complexity and liking have different relationship according to the musical genre examined, and that these two variables are also affected by other factors such as familiarity to the music and expertise of the listener. Although previous experiments have examined several genres such as *jazz*, *pop*, *rock* and *bluegrass*, surprisingly, no study has focused on contemporary music.

In this paper, we fill this gap by studying the relationships between complexity, liking, musical training and familiarity in the case of contemporary music. By analysing this genre – which is usually underrepresented in music cognition – it is possible to shed some light on the correlation between liking and complexity in the case of highly complex music. To obtain data, a multifactor experiment was designed in which both music experts and novices had to provide scores of subjective complexity and liking for four 30-second long excerpts of contemporary music with different degrees of complexity. Empirical results suggest that liking and complexity are negatively correlated in the case of contemporary music and that listeners' expertise does not influence the perceived complexity of musical pieces, but it can significantly affect liking. This possibly indicates that experts have the musical knowledge needed to appreciate extremely complex music, while novices do not.

I. INTRODUCTION

Why does the majority of people listens to pop/rock music and not to contemporary music? At first glance, this question seems to be related to cultural habits only. Our society largely promotes pop music because of the huge profits it generates. Pop songs are everywhere on television and on the radio, and it is difficult for a person not to stumble upon the last hit. On the other hand, contemporary music is followed by a small niche of people and it is hardly aired even on classical music radio stations. However, what happens in our society might also be a reflection of basic cognitive processes related to the musical content of these two genres. Obviously, people listen to the music they like. Numerous studies (e.g, Vitz, 1966; Berlyne, 1971; Heyduk, 1975; Walker, 1980) suggest that listeners find a piece of music more or less pleasant based on its complexity. Listeners do not like music which is overly complicated, like most of contemporary music, because it is difficult to understand. On the other hand, listening to music which is too simple is boring. Therefore, people prefer music of intermediate levels of complexity like pop/rock music (Orr & Ohlsson, 2001).

Several studies support this *inverted-U hypothesis* (Vitz, 1966; Crozier, 1974; North & Hargreaves, 1995; Orr & Ohlsson, 2001). Vitz (1966) found that the aesthetic assessment for a series of tones increases along with complexity until it starts declining when the melody becomes too complex. Likewise, North and Hargreaves (1995) discovered that pop songs of moderate complexity are preferred by listeners to songs that are perceived as too simple or too complex. However, there are some studies in the literature that contradict the inverted-U hypothesis. Russell (1982) and Smith and Melara (1990) found a negative correlation between liking and complexity. In both studies, simple musical excerpts were preferred to complex fragments. Although less frequent than the experiments which support the inverted-U hypothesis, these results might suggest that liking and complexity have different relationships depending on the musical style analysed and on other factors such as familiarity to the music proposed and level of expertise of the listener. Until now, a number of genres have been examined in controlled experiments. For instance, Orr and Ohlsson (2001) focused on *jazz* and *bluegrass*; North and Hargreaves used both pop songs (1995), and *new-age* music (1996). Both classical music and *avant-garde jazz* were tested by Hargreaves (1984).

All studies which attempt to find a relationship between liking and complexity face a great challenge, i.e., defining musical complexity. Complexity is a fuzzy concept difficult to measure. To simplify this notion it is possible to divide complexity into two separated concepts: *objective complexity* and *subjective complexity* (Hargreaves, 1984). The former refers to the objective amount of complexity carried by a musical piece based on its properties. Previous studies measured objective complexity relying on the tools of information theory (Vitz, 1966), or by performing feature analysis (Steven & Latimer, 1991). Subjective complexity, on the other hand, is the amount of complexity experienced by people while they listen to a musical piece (Steven & Latimer, 1991). Subjective complexity is a function both of objective complexity and of the musical background of the listener. Regarding the musical background, a piece that is perceived as simple by a listener who grew up listening to Western music can be experienced as extremely complex by a listener who spent her life in an African musical environment. The opposite is obviously true as well. Although it is difficult to predict subjective complexity on a theoretical basis, there is a simple strategy to measure it: asking listeners to rate complexity in a scale while they listen to music (North & Hargreaves, 1995; Orr & Ohlsson, 2001).

A major concern to address when studying the relationship between liking and complexity is the type of musical stimuli used during the experiments. For example, Vitz (1964; 1966) used computer-generated melodies and Smith and Malera (1990) used chord progressions. These kinds of stimuli lack several of the musical strategies adopted by musicians to nuance their performances such as *rubato* and *rallentando.* Therefore, the musical result might be mechanical and lack ecological validity. This problem was solved by North and Hargreaves (1995) who used 30-second long pop music excerpts, and by Orr and Ohlsson (2001) who used short improvisations expressly created by jazz and bluegrass musicians for their experiments.

Although important, complexity is not the only factor which influences liking. Repetition plays a central role both for subjective complexity and for perceived pleasingness (Hargreaves, 1984; Tan, Spackman & Peaslee, 2006). Stevens and Latimer (1991) found that repeated hearings of musical excerpts increased their liking and decreased their subjective complexity. An experiment conducted on elementary school children confirmed that repetition plays an important role in liking (Moskovitz, 1992). Children were divided into two groups. The experimental group listened to repeated excerpts drawn from baroque, classical, romantic and atonal music with slow tempos; while the control group listened to the same music with both slow and fast tempos. The experimental group significantly exceeded the control group in its choice of slow-tempo music. Therefore, repetition had a relevant impact on children's preference for slow music. Not only repeated hearings influence liking and complexity, but also repetition of musical fragments within a piece. Ollen and Huron (2004) found that listeners prefer compositions where musical passages are repeated early. In another experiment (Margulis, 2013), people listened to pieces in an unfamiliar style. Apart from the original version, they listened to a second rendition which was altered by researchers who inserted several times in the piece the same musical passage drawn from the piece itself. Listeners found the version with several repetitions more interesting and enjoyable than the unaltered piece. All these empirical studies suggest that repetition is central for musical preference.

Liking and complexity is also a function of the expertise of the listener. However, it is not yet clear whether or not complexity and repetition have a different effect on liking depending on expertise. For example, Orr and Ohlsson (2005) found that for expert listeners the inverted-U relationship between liking and complexity cease to exist in the case of jazz music. However, North and Hargreaves (1995) examining pop music could validate the inverted-U hypothesis both for experts and non-experts. Specifically, they found that the "optimal complexity" for experts is higher than that for novices. The same result was reached by Steven and Lantiner (1991). Therefore, it might be speculated that a qualitative different aesthetic response between trained and untrained listeners depends on the musical style analysed.

In this paper, we examine the relationships between subjective complexity, liking and repetition in contemporary music, a style which is underrepresented in music cognition. Differences between the liking behaviours of music experts and non-experts are also studied. We chose contemporary music because no previous study we are aware of considered this genre, and because it could provide useful information about the correlation between liking and complexity in the case of highly complex music. Indeed, if an inverted-U correlation between liking and complexity was to be found, this would support its general validity across musical genres. Furthermore, few studies consider altogether the effects of repetition, complexity and expertise on liking (Stevens & Latimer, 1991; North & Hargreaves 1995). In their work, Steven and Latimer (1991) used musical stimuli expressly composed for the experiment which lacked ecological validity; and the study by North and Hargreaves (1995) focused only on pop music. Considering complexity, repetition and expertise altogether is a necessary approach to have a global picture of the liking behaviour of people.

Based on the research we have introduced, we propose the following research hypotheses:

a. Multiple exposures to a contemporary composition lower its level of perceived complexity both for experts and novices.
b. Experts find contemporary pieces less complex than novices do.
c. Experts like contemporary pieces more than novices do.
d. Listeners (i.e., experts and novices) who listen to a piece of contemporary music multiple times like it more than people who listen to it only once.
e. In the case of experts, liking and complexity for a contemporary piece of music follow an inverted-U curve.
f. In the case of novices, for a contemporary composition there is a negative correlation between liking and complexity.

The experiment we set up is designed to verify these four hypotheses. Are complexity and liking correlated in contemporary music? Does repetition affect complexity and liking? Do music experts and novices behave in different ways?

II. METHODS

In this section, we provide details about experimental design, participants, materials and procedure.

A. Design

In the experiment, participants listened to four excerpts of contemporary piano music and were asked to provide a score for subjective complexity and liking. The fragments were chosen so that they had different levels of complexity. To evaluate the objective complexity of musical passages, we used an approach based on feature analysis already employed by Stevens and Latimer (1991). With this strategy, the global complexity could be derived from the level of complexity of several musical features such as *tonality*, *sounds per bar*, *rhythm perceived speed*, *cohesion*, *melody* and *variation*. The *tonality* feature depends on key centres and harmonic progressions. *Sounds per bar* considers the overall number of chords in a bar. *Rhythm* is a temporal feature that relates to the regularity of the durational patterns. *Perceived speed* is a function of the interaction of metre with rhythm and sounds per bar. *Cohesion* refers to the unity of a piece based on the homogeneity of harmonic and rhythmic patterns. The *melody* feature relates to the magnitude of intervals. *Variation* refers to variation in pitch, rhythm and harmony. Each feature could get a value from 0 to 3, that represents a categorical assessment for the feature. For example, in the case of *sounds per bar*: "0" indicates two or less sounds per bar, "1" designates three to four sounds, "2" refers to five to eight sounds, and "3" indicates more than eight sounds. The overall score for complexity was obtained by summing all the values for each feature. Of course, this measure does not guarantee a perfect assessment of the objective complexity of a piece of music, but it provides an operational measure which can be used to effectively control the independent variable *objective complexity*.

To account for the effect of repetition on subjective complexity and liking, we prepared four excerpts which contained four repetitions of the same initial 30-second long fragments. As a consequence, there were two groups of four stimuli: one with the original 30-second long musical passages and the other with the same fragments repeated four times. We divided subjects into music *experts* and *novices* based on their musical training. To be regarded as *experts*, participants had to have studied music for more than eight years. *Novices* had no previous musical training.

To summarise, the experiment had three independent variables (i.e., *expertise*, *repetition*, *piece*) and two dependent variables (i.e., *subjective complexity* and *liking*). An account of all the variables and their levels is provided in Table 1.

Table 1. Considered variables and their corresponding levels.

Variable	Levels
Expertise	Expert, Novice
Repetition	Repeat, Non-repeat
Piece	A, B, C, D
Liking	7-point scale
Subjective complexity	7-point scale

Two levels for the factors *expertise* and *repetition* produced four independent experimental conditions: *novices*/*repeat*, *novices*/*non-repeat*, *experts*/*repeat* and *experts*/*non-repeat*. In each condition, participants had to listen to all four pieces. Participants in the level *non-repeat* of the factor *repetition* listened to the original 30-second long fragment for each of the four pieces, whereas subjects in the level *repeat* listened to the stimuli with each fragment repeated four times. Therefore, the complete design involved three factors: *expertise*, *repetition* and *piece* – with repeated measures on the latter. To avoid possible order effects, fragments were played back randomly. The experiment was conducted on the Internet.

B. Participants

105 participants took part in the experiment. Of these, 41 were novices, 23 had between one and eight years of training and 42 were experts. Of these three groups, we used the results of novices and experts only. To find participants, we posted messages on social networks and on online communities of musicians, music lovers and psychology students. The mean age of subjects was 32.7 (*SD* = 11.3).

C. Materials

Table 2. List of contemporary piano pieces from which the 4 considered excerpts have been extracted.

Code	Piece
A	*Fur Alina*, by Arvo Part (1976)
B	*Romance*, by Toru Takemitsu (1949)
C	*Variations op.27 no.2*, by Anton Webern (1936)
D	*Piano Sonata no.1*, by Pierre Boulez (1948)

In the experiment, we used four 30-second long excerpts (i.e., A, B, C, D) of contemporary piano music with different levels of complexity. A list of the pieces from which musical fragments were extracted is given in Table 2. The order of objective complexity of the four passages found with feature analysis was $D > C > B > A$. Of course, this is not a perfect measure of complexity, but it gave us an idea of the amount of information carried by each excerpt. We chose real compositions rather than creating *ad hoc* fragments, to guarantee ecological validity for the study. At the same time, only piano music was employed so that participants were exposed to fragments with similar timbre. If ensemble music had been used, it would not have been possible to control the amount of time played by each instrument; therefore stimuli would have presented radically different timbre. The audio of the four compositions were extracted from Youtube videos[1] and edited with Cubase 5. In the editing process, we isolated four 30-seconds long passages, and arranged a second track for each of the four fragments, which consisted of the same passage repeated four times. Each repetition was separated from the previous one by four seconds of silence. We chose four repetitions so that listeners could familiarise with the music without getting bored by it. All eight excerpts employed in the experiment can be found at the following website: http://helios.hud.ac.uk/scommv/storage/escom15.zip.

We used two 7-point scales for rating *subjective complexity* and *liking*. In the case of complexity, a score of "1" indicated that an excerpt was "no complex at all", while a score of "7" that it was "extremely complex". For aesthetic assessment, "1" meant that a participant "did not like a piece at all", whereas "7" indicated that she "liked a piece very much".

We developed a dedicated website to host the experiment, which was made up of two parts: an interface and a database. The interface was necessary to provide information to participants, allow them to play music and provide their evaluations. The database was used to store the subjects' answers.

D. Procedure

The experiment comprised four steps. When participants initially accessed the website of the experiment, we provided them with instructions. An introductory text explained that they were going to listen to four excerpts of music, and that they both had to rate the complexity of those pieces and had to indicate how much they liked each fragment. We assured participants that no musical skills were needed to take the

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[1] http://goo.gl/XnDJFD, http://goo.gl/ksRdfe, http://goo.gl/e2zubQ, http://goo.gl/akV7IP.

experiment, and that results would remain anonymous and would be used only for research purposes.

After reading the instructions, participants could move to the next webpage of the experiment where they listened to the musical passages and rated them for complexity and aesthetic value. Each excerpt was rated immediately after it ended.

In step three, participants provided personal details about age and years of musical training. Finally, in step four, they accessed a debriefing page, in which we clarified the aim of the experiment and provided our contacts, in case subjects were interested to learn more about the research.

III. RESULTS

In this section we present the results of the performed analysis.

A. Subjective Vs Objective Complexity

We used the Pearson's product-moment coefficient to look for a correlation between the ratings of complexity provided by participants and the values of objective complexity obtained with feature analysis. The two sets of scores correlated strongly and positively $r(5) = 0.951$, $p = 0.049$. The order for the complexity of fragments provided by subjects was the same as that found with objective complexity measures: $D > C > B > A$.

B. Effect of Expertise and Repetition on Complexity

A three-way mixed-groups ANOVA was performed to understand the impact of *expertise*, *repetition* and *piece* on *subjective complexity*. *Expertise* and *repetition* were considered as between-subjects factors, whereas *piece* was the within-subjects independent variable. As expected, there was a main effect of *piece* on *complexity* $F(3,237) = 90.4$, $p < 0.001$, which was consistent with the previous results on correlation between subjective and objective complexity.

The interaction between *piece* and *expertise* was significant: $F(3,237) = 3.40$, $p = 0.019$. The effect size was small (partial eta squared = 0.041). As Figure 1 suggests, the only time in which there was a significant mismatch in the judgment of complexity between novices and experts was fragment *D*. Contrary to what expected, experts found fragment *D* more complex (M = 5.9, SD = 0.97) than novices did (M = 5.1, SD = 1.36): $t(81) = 3.11$, $p = 0.03$, two-tailed.

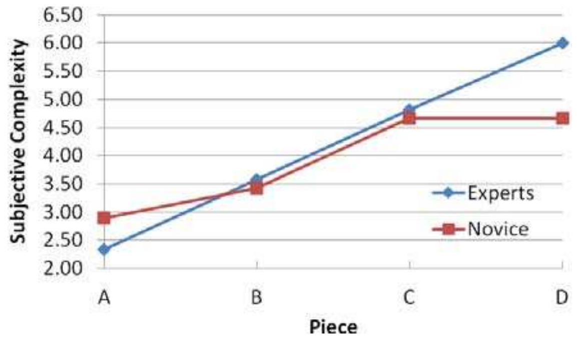

Figure 1. The *Subjective Complexity* perceived by Experts and Novices across all the considered pieces with repetition.

The interaction between *repetition* and *piece* on *complexity* was significant: $F(3,237) = 3.42$, $p = 0.018$. Once again, the effect size was small (partial eta squared = 0.041), and there was one simple effect only. Specifically, a significant difference between the complexity measured in fragment *C* in the case of *repeat* (M = 4.7, SD = 1.4) and *non-repeat* (M = 4.01, SD = 1.4) was discovered: $t(81) = 2.03$, $p = 0.046$, two-tailed.

C. Effect of Expertise and Repetition on Liking

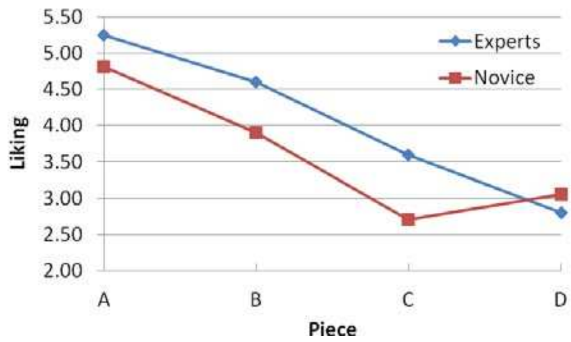

Figure 2. The *Liking* of Experts and Novices across all the considered non-repeated pieces.

To gauge the impact of *expertise*, *repetition* and *piece* on *liking* we used a three-way mixed-groups ANOVA with *expertise* and *repetition* as between-subjects factors and *piece* as the within-subjects factor. The only effect we could find with this test was the main effect of *piece* on *liking*: $F(3,237) = 39.0$, $p < 0.001$. The effect size was strong (partial eta squared = 0.33). As shown in Figure 2, both experts and novices tended to like *A* more than *B*, *B* more than *C*, and *C* more than *D*; except for novices who liked *D* more than *C*.

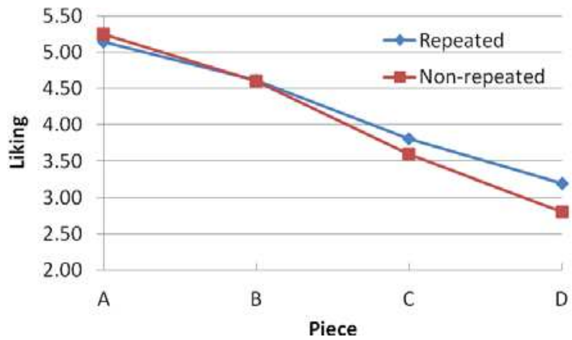

Figure 3. The *Liking* of Experts across considered pieces with and without repetition.

A between-subjects ANOVA confirmed that experts and novices expressed significantly different ratings for *liking*. Indeed, the main effect of *expertise* on *liking* was significant: $F(1,79) = 14.8$, $p < 0.001$. As can be inferred from Figure 3, *repetition* appeared to have no impact at all on *liking*.

IV. DISCUSSION

As in the study by Stevens and Latimer (1991), a strong correlation was found between the measures of subjective complexity obtained from the ratings of the participants and those of objective complexity obtained with feature analysis. This correlation will allow us to draw conclusions about the relationship between *liking* and *complexity*, because the four chosen fragments effectively represent four distinct degrees of complexity; and therefore can be used as an indirect measure of complexity.

Both for novices and experts, no evidence was found that multiple exposures to a contemporary composition lower its level of perceived complexity. In fact, the only simple effect identified in the case of fragment *C* shows that participants found the *repeat* level more complex than the *non-repeat* level. This seems to imply that – for contemporary music – multiple hearings allow listeners to recognise all the subtleties of a composition, which might result in an increase of *subjective complexity*. However, this argument cannot be generalised due to the lack of evidence. The absence of a main effect of *repetition* on *complexity* contradicts the findings obtained by Latimer and Stevens (1991). A possible explanation might be that four repetitions are not enough to decrease the perceived complexity in the case of contemporary music compositions.

Contrary to what expected, experts did not find contemporary pieces less complex than novices did. Indeed, there was no general difference in perceived complexity between experts and novices. This fact seems to imply that subjective complexity – at least in the case of contemporary music – does not depend on musical training. The only significant difference was for piece *D* that was recognised as significantly more complex by experts. A plausible explanation for this phenomenon might be the fact that experts are equipped with the musical knowledge needed to acknowledge the complexity of extremely complex music, while novices are not.

As expected, liking ratings of experts were significantly greater than those of novices (see Figure 2). Considering the fact that scores of subjective complexity were not statistically different for experts and novices, we should ascribe the difference in liking to musical training only. It is probable that the greater familiarity of experts with contemporary music led them to provide scores for liking that were significantly higher than those provided by novices. This supports the general hypothesis that familiarity with a musical style is a key aspect for liking.

Contrary to our initial research hypothesis, both for experts and novices *repetition* had no impact on *liking* (see Figure 3). However, this is perfectly in line with the lack of effect of *repetition* on complexity. Indeed, the reason why an increase in the ratings of liking was expected when fragments are repeated was due to the decrease of perceived complexity in the case of repeated fragments. Since the latter phenomenon did not happen, the former could not possibly occur as well.

Figure 2 suggests that there was a clear negative correlation between *liking* and perceived *complexity* in the case of expert listeners. In other words, the more complex a piece it is, the less it is liked. This goes against the general accepted inverted-U hypothesis, but it is in line with other studies (Russell 1982; Smith & Melara 1990). The lack of an ascending leg which could support the inverted-U hypothesis in our study might be due to the small number of fragments used (i.e., 4). Indeed, it could be that all of the chosen fragments are already too complex, and that what we see in Figure 2 is the descending leg of the inverted-U curve. However, fragment *A* is extracted from an extremely low complex composition which belongs to *minimalism*. In that regard, it is difficult to find a contemporary music piece which is radically less complex than *A*. On the other hand, we suggest that for intrinsically complex musical genres, like contemporary music and *avant-garde jazz*, we should rely on negative correlations of liking and complexity rather than on inverted-U relationships. This is the case because even the simplest musical instances of these genres might be enough complex to result interesting. As a consequence, in these genres the ascending leg of the inverted-U curve is practically nonexistent.

A similar negative correlation between complexity and liking is suggested by Figure 2 for novices as well. However, in this case it is interesting to notice that *D* – which is the most complex fragment – has a liking rating which is greater than that of *C*. This can be explained by the fact that there is no significant difference in the subjective complexity of *C* and *D* considering the ratings of novices and ignoring those of experts. This seems to support the idea discussed above that musical training is needed in order to recognise the complexity of highly complex pieces.

The experimental design has some limitations that should be overcome in future studies. First, we used only four fragments. Although this seems enough to understand the effects of repetition and expertise on complexity and liking, it has probably weakened the results obtained with regard to the relationship between complexity and liking. Furthermore, 30-second long fragments might be too short for participants to form an idea for the scores of complexity and liking. However, the use of such short fragments was necessary, since the experiment was held online. In the future, we will propose an improved version of this experiment to confirm the results of this study which goes against the literature. In the new research, we will have a lab-based experiment with a greater number of fragments, which will be longer.

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