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# The Effect of Repetitive Structure on Enjoyment in Uplifting Trance Music

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## ABSTRACT

Whereas previous studies have examined the effect of rhythmic structures in trance music, the present research explores the impact of harmonic repetition on enjoyment through empirical testing. A number of uplifting trance (UT) excerpts were generated with different semiotic patterns (structures defining the order of chords in the sequence) each with varying levels of harmonic repetition. Listeners then provided enjoyment ratings for each of the excerpts. The results of the experiment indicate that harmonic repetition, not only rhythmic or percussive structure, does in fact contribute to the enjoyment of uplifting trance music. Depending on the harmonic context, greater chord diversity or maximal repetition elicits high enjoyment.

## I. INTRODUCTION

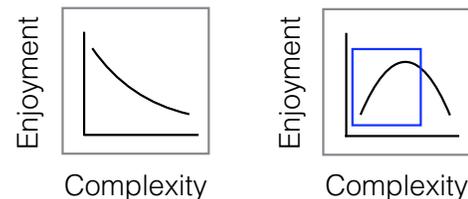
Across cultures, various forms of trance music are often used to evoke alternative listening states, such as heightened enjoyment and a sense of becoming “lost in the music” (Sacks, 2006). Repetition is thought to be crucial for evoking these listening states (Walsh, 1989), yet the particular repeated elements influencing affective response in listeners remain unclear. Previous research focuses upon the intuitive connection between rhythmic/percussive elements and the physiological entrainment underpinning heightened enjoyment (Becker-Blease, 2004; Becker, 2012; Fachner, 2011; Neher, 1962; Trost, Frühholz, Schön, Labbé, Pichon, Grandjean & Vuilleumier, 2014), but we focus on a less understood element of trance music: harmonic repetition. We aim to elucidate how local harmonic structure (e.g., chord progressions) contributes to the experience and enjoyment of ‘uplifting trance’ (UT) music, a sub-genre of electronic dance music characterized by repetitive melodies, chord sequences, and rhythmic patterns (Madrid, 2008). UT pieces have a particular musical structure that includes distinctive functional sections known as the *breakdown*, the *buildup*, and the *anthem*. This study places the most distinctive and fundamental elements of a UT piece in focus: the anthem, arguably the energetic height of the UT listening experience. The next section describes a behavioral experiment that was conducted in order to test the relationship between local harmonic structure and listeners' enjoyment.

## II. BEHAVIORAL EXPERIMENT

### A. Hypotheses

To elucidate the connection between repetition of harmonic structure and subjective enjoyment, we conducted a

behavioural experiment in which listeners provided enjoyment ratings for UT anthems varying in repetitiveness of chord sequences. Two alternative hypotheses were considered: 1) Listeners display a preference for repetitive harmonic structures (more complex patterns yield less enjoyment, as shown in the left plot of Figure 1), and 2) Enjoyment reflects the inverse-U relationship between preference and complexity predicted by the Wundt curve (Berlyne, 1970) (shown in the right plot of Figure 1), which has been demonstrated for other musical genres (Heyduk, 1975; Huron, 2006; North & Hargreaves, 1995). Note, however, that very complex stimuli (those that should yield very low enjoyment ratings according to the Wundt curve) were not included in this study, because the research aimed to maintain as much ecological validity as possible, and because generating very complex sequences was often not possible given the simple semiotic structures employed (see next section for details). As a result, this research addresses a portion of the Wundt hypothesis (outlined in blue in Figure 1): that greater chord diversity in the stimuli (higher complexity / lower repetitiveness) generally results in greater enjoyment.



**Figure 1.** Depicted on the left is Hypothesis 1, that enjoyment decreases as stimuli become less repetitive and more complex. Depicted on the right is Hypothesis 2, which displays the relationship between preference and complexity as predicted by the Wundt curve. Because no very complex stimuli were included in this research, the study only addresses the portion of the curve outlined by the blue box.

### B. Method

In the behavioral experiment, listeners provided enjoyment ratings for UT excerpts varying in harmonic repetition. The sequence of chords within each stimulus was determined by an underlying semiotic pattern, and a total of 14 different semiotic patterns were used to constrain harmonic repetition (see Table 1). The symbols A, B, etc, do not refer to explicit chord names, but are labels indicating the order and repetition of chords within the semiotic patterns. Each label corresponds to a chord that has a duration of two bars, and therefore every

pattern has a duration of 16 bars.

**Table 1. The 14 semiotic structures used in the experiment.**

AABB-AAAA	ABCD-ABCD
AABB-AABB	ABCD-AECF
AABB-AACC	ABCD-BCDB
AABB-BBAA	ABCD-CECF
AABB-CCAA	ABCD-DADB
AABB-CCAB	ABCD-EFAB
AABB-CCDE	ABCD-EFGH

The semiotic patterns were created such that the first 8 bars were either ABCD or AABB. The second 8 bars fell into three categories when considering the particular chord *and* its metrical position in the pattern: either the semiotic structure of the first half was completely preserved (as in AABB-AABB and ABCD-ABCD), some of the semiotic structure of the first half was preserved (e.g., AABB-AACC and ABCD-CECF, where the repeated chords are in bold), or none of the semiotic structure of the first half was preserved (e.g., AABB-CCDE and ABCD-DADB). Finally, the number of unique chords in the second half of the semiotic structure ranged from 1 chord (AAAA) to 4 chords (ABCD or EFGH). The semiotic structures used in the listening experiment are displayed in Table 1.

The listeners were presented with a total of 56 UT anthems (4 instances per unique semiotic pattern), each 30 seconds in duration, and the order of trials was randomised across participants. Two practice trials were played before the experiment to help the participant become familiar with the experimental procedure. After listening to each trial, the listeners' task was to provide enjoyment ratings on a 7-point Likert scale, where 1 was equivalent to 'Did not enjoy at all' and 7 represented 'Enjoyed very much.'

The experiment was conducted on a MacBook Pro laptop using a GUI constructed for data collection for this experiment. Participants listened to the stimuli through headphones set at a comfortable listening volume, in a quiet room.

### C. Participants

Twenty volunteers, recruited via email advertisement and flyers around the Queen Mary University of London campus, participated in the experiment (mean age = 28.6 yrs, std = 7.9 yrs; 6 female and 14 male). Participants included undergraduate students, graduate students, and staff, all of whom reported prior experience listening to trance music. Each volunteer received £7 for his or her participation.

### D. Stimulus generation

To avoid any potential confound of the actual chords presented (as opposed to the overarching semiotic structure), four different stimuli were generated for each semiotic structure listed in Table 1. To this end, the first chord of each sequence was either Bmin, Dmaj, Emin or Gmaj. The generation was performed using a method which allows sampling high probability chord sequences with respect to a given semiotic structure (Conklin, 2015). Sequences were generated from a statistical model that encodes chord transition probabilities of a corpus of 100 uplifting trance

chord loops designed specifically for this study<sup>1</sup>. The sequences with the highest probability between successive chords were selected and key modulations within the sequences were avoided as much as possible. Each chord sequence was then rendered within the Digital Audio Workstation Logic Pro X (LPX) by starting from an existing uplifting trance template<sup>2</sup> and applying as few as possible pitch modifications necessary to make its harmonic structure fit with the generated chord sequence (Bigo & Conklin, 2015). As this transformation task leaves rhythm, instrumentation, and audio effects unchanged, the generation results in a set of stimuli that differ by their harmonic properties. The entire generation process was automated by using a system which interacts with LPX through the MIDI protocol (Conklin & Bigo, 2015).

### E. Results

To test the impact of repetition on enjoyment ratings, a 2 X 3 X 4 ANOVA was conducted for three types of repetition found within the semiotic structures as described above. These three repetition variables were: 1) the structure of first 8 bars (AABB or ABCD), 2) the number of chords in common, and in the same metrical position, between the first and second 8 bars of the sequence (all the same, partially the same, or no common chords), and 3) the number of unique chords in the second 8 bars (ranging from 1 to 4 chords).

There was a significant effect of variable 3 (the number of unique chords in the second 8 bars),  $F = 4.24$ ,  $p < 0.01$ , such that more chord diversity yields higher enjoyment ratings. A significant interaction was also found between variable 1 (semiotic structure of first 8 bars) and variable 2 (all, some, or no chords in common between the first and second 8 bars),  $F = 4.09$ ,  $p < 0.05$ . Highest enjoyment ratings were elicited when all the same chords were present in the first and second half of the stimulus (AABB-AABB and ABCD-ABCD). For stimuli beginning with ABCD, high enjoyment ratings were also found when none of the same chords were present in the first and second half of the stimuli. The lowest enjoyment ratings were elicited when the second 8 bars contained only some of the same chords as the first 8 bars, especially for stimuli beginning AABB. Lastly, a post hoc analysis indicated that semiotic patterns occurring in the Uplifting Trance Anthem Loops Corpus (i.e. native structures) were preferred over those not in corpus,  $t = 2.36$ ,  $p < 0.01$ .

### F. Discussion

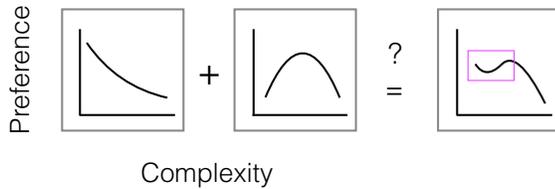
Although there was a trend of increasing enjoyment for stimuli with less repetition in the last 8 bars (that is, more unique chords in the second half of the stimulus), this was not true for sequences beginning AABB. The findings indicate that enjoyment is elicited by semiotic patterns that are either very repetitive, namely, AABB-AABB and ABCD-ABCD, or fairly complex, such as ABCD-EFAB and ABCD-BCDB; but enjoyment does not result from sequences that are only slightly repetitive, such as AABB-AACC. Violations of

<sup>1</sup> The Uplifting Trance Anthem Loops Corpus (UTALC) which was constructed for this study may be found here: <http://www.lacl.fr/~lbigo/utalc>

<sup>2</sup> Uplifting Trance Logic Pro X Template by Insight, DAW Templates, Germany.

stylistic form (e.g., culminating a semiotic pattern with AA when a chord change is expected) were also disliked.

Overall, the results did not fully support or reject either of the two hypotheses; rather, we speculate that listeners' enjoyment reflects a combination of the two. Although evidence was not found across all semiotic patterns to support the first hypothesis (that greater repetition yields greater enjoyment), most of the highest rated sequences were the most repetitive sequences in the study (AABB-AABB and ABCD-ABCD). The second hypothesis, that enjoyment increases as complexity increases, up to a certain point (the climax of the Wundt curve, and the portion of the curve tested here), was also supported in part: stimuli containing only slightly repetitive chords were disliked compared with stimuli containing little to no repetition (that is, more complex harmonic structures produced higher enjoyment ratings than moderately complex structures). A schematic of this theoretical combination of hypotheses is depicted in Figure 2. These preliminary findings may suggest that listeners' preferences are divided, with greatest enjoyment elicited by either the most repetitive harmonic structures (the lefthand maximum of the pink box in Figure 2) or fairly complex, varied structures (the righthand maximum of the pink box). Again, no highly complex sequences were included, as this study focused only upon low to moderately complex stimuli.



**Figure 2. The experimental results are accounted for by a combination of the first two hypotheses.**

### III. CONCLUSION

By systematically investigating the repetitiveness of semiotic structures, we have discovered specific contexts in which chord repetitions influence the enjoyment of UT music. These preliminary findings suggest that harmonic repetition, not simply repetitive rhythmic and percussive structures, do in fact contribute to enjoyment of this genre. The authors are currently working on a follow-up study to further substantiate these results. Future work will explore the connection between repetitive harmonic elements and altered listening states signifying heightened enjoyment, such as audience flow.

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