

The Structure of Chord Progressions Influences Listeners' Enjoyment and Absorptive States in EDM

Kat Agres¹ and Dorien Herremans^{1,2}

¹ *Social and Cognitive Computing Department, Institute of High Performance Computing, A*STAR, Singapore*

² *Information Systems Technology and Design, Singapore University of Technology and Design, Singapore*

¹kat_agres@ihpc.a-star.edu.sg, ²dorien_herremans@sutd.edu.sg

Abstract

The field of music cognition has given comparatively little consideration to the topic of altered listening states, such as audience flow, trancing, and absorptive states. Some research has investigated the relationship between musical features (such as repetitiveness or information-theoretic characteristics) and enjoyment of the music, but the impact of musical structure on absorptive states has yet to be thoroughly addressed. The present study sought to fill this gap in the literature by examining harmonic structure, enjoyment, and absorptive listening states in Uplifting Trance (UT), a sub-genre of Electronic Dance Music (EDM). Rather than examine the obvious (and previously considered) connection between driving rhythmic cues and absorptive listening states, we aimed to investigate the effect of harmonic repetition on listening states. Based on previous work (Agres, et al, 2017), we generated a number of UT excerpts with varying degrees of harmonic repetition. These excerpts were used in an online listening task with 19 experienced trance/EDM listeners. We discovered that chord progressions significantly influenced both listeners' enjoyment of the music as well as their reported absorptive listening states. Overall, the results from this study indicate that moderately complex chord sequences elicit greater enjoyment than very repetitive chord sequences or sequences that violate listeners' expectations. A significant correlation between highly enjoyed sequences and absorptive listening states was also observed.

Introduction

From tribal cultures to western electronic dance music (EDM) contexts, trance music helps listeners achieve altered listening states (Kartomi, 1973; Kakouri, 1965). The precise musical features and mechanisms responsible elucidating these altered states are still a topic of investigation by scientists around the world (Becker-Blease, 2004; Becker, 2012; Fachner, 2011; Neher, 1962; Trost, Frühholz, Schön, Labbé, Pichon, Grandjean & Vuilleumier, 2014). The relationship between harmonic structure and enjoyment of EDM has previously been investigated by the authors (Agres, Herremans, Bigo & Conklin, 2017), however, the influence of chord progressions on *absorptive listening (AL) states* has remained unexplored.

Different terms have been used in the literature to refer to the wide range of experiences that may be elicited from music, such as 'trancing' and 'altered states of consciousness' (see for example Ludwig, 1966; Silverman, 1968; and Becker-Blease, 2004). Different connotations are attached to each of these alternatives. In this paper, we focus on 'absorptive listening states', which refer to the experience of being deeply engulfed in music. Although there is intuitively a connection

between enjoyment and the sense of being absorbed in the music, this topic has not been formally addressed. The current work makes use of an empirical listening task with EDM experts to fill this gap in the literature.

Existing research has examined the influence that rhythmic and percussive elements have, through entrainment and auditory driving, on heightened enjoyment (Becker-Blease, 2004; Becker, 2012; Fachner, 2011; Neher, 1962; Trost et al., 2014). Because ample research suggests that these temporal cues do have an impact on absorptive listening states, the authors have instead chosen to examine a feature of trance music less studied in this context: harmonic structure.

In previous work, a listening experiment was conducted to examine the relationship between harmonic structure and enjoyment of EDM trance music (Agres et al., 2016; Agres et al., 2017). In this study, expert participants listened to excerpts of uplifting trance (UT)¹ music containing varying degrees of harmonic complexity (details in Method section below). The experiment by Agres et al. (2017) provided evidence for a significant connection between enjoyment and harmonic structure of UT excerpts, as defined in terms of repetitiveness, complexity, and tension. The degree of harmonic complexity of the UT stimuli was carefully controlled by imposing certain *semiotic structures*, or patterns of chord progressions, on the 16-bar-long stimuli. Fourteen different semiotic structures (which varied from extremely repetitive to moderately complex) were examined, with one such example being 'AABB-AACC'. In this semiotic structure, the first chord is repeated for four bars (note that each element in the pattern represents two bars of music), followed by a different chord for four bars, which is then followed by the first chord for four bars, and so on. Also note that each element represents a unique chord, not a chord name. For more information regarding the stimuli and how they were generated, the reader is referred to Agres, et al. (2017).

The results of the study indicated that trance excerpts with moderately repetitive chord sequences are most highly enjoyed, with participants demonstrating a preference for moderate harmonic complexity and tonal tension (as defined by Herremans & Chew, 2017). Further, sequences whose structure violated the expected form (such as AABB-AAAA, in which the third 'A' chord in the second half of the sequence is unexpected), created a lack of enjoyment in listeners. These findings suggest that the enjoyment of uplifting trance music may be related to the predictability of its underlying harmonic

¹ Uplifting trance is a sub-genre of EDM typically in the range of 135-150 beats per minute, with a song structure often comprised of intro, breakdown, build-up, release, anthem and outro sections (Madrid, 2008).

structure: extremely repetitive chords as well as unexpected chords are not always enjoyed by listeners, whereas chord progressions that are moderately expected are better enjoyed. The pattern of results can be described by a Wundt curve (see Berlyne, 1970), and this inverted-U relationship between complexity and enjoyment (or liking) has also been found in other musical genres, such as jazz (Gordon and Gridley, 2013) and bluegrass music (Orr and Ohlsson, 2001). Arguably, the one of the highest forms of enjoyment of UT music is reaching an absorptive state, however Agres et al. (2017) did not directly test the connection between chord progressions and AL states.

In both modern EDM settings and in numerous tribal cultures, trance music has been associated with reaching absorptive states of consciousness, yet again, no research has investigated whether harmonic structure contributes to this experience. Therefore, this study aimed to investigate the influence of harmonic structure on reaching AL states. We also sought to replicate and further validate the results of Agres, et al. (2017), which found that harmonic structure has a significant influence on enjoyment. In the present study, conducted solely with expert listeners, we use longer trance excerpts that are more ecologically valid, and provide listeners with a greater opportunity to “lose themselves in the music.” Finally, we sought to explore the relationship between enjoyment ratings and reported absorptive listening states.

Behavioural Experiment

In an online listening experiment, we investigated the nature of the influence of harmonic structure on both enjoyment and self-reported ability to reach absorptive listening states. Several hypotheses drove this project. First, we hypothesised that harmonic structure influences the (self-reported) ability of listeners to reach AL states. Secondly, we predicted that harmonic structure (i.e., chord sequences) in UT music influences listeners’ enjoyment ratings in longer, more ecological musical stimuli (we aimed to replicate and extend the results from Agres et al. (2017), which used brief UT excerpts). Our third hypothesis was that enjoyment and absorption are linked responses; that is, that listeners’ enjoyment of the music would be directly related to their self-reported AL state.

Method

Participants. The study was advertised through email and on trance production forums, which resulted in a total of 25 responses. Because we wanted a population of expert listeners, only participants with a minimum of one year of experience DJing, composing, or producing trance music were included in the study, which resulted in a total of 19 participants (mean age = 33.4 yrs, std = 10.5 yrs; 19 male). These expert participants had on average 9.6 years (std = 7.7 yrs) experience DJing, composing, or producing trance music. To encourage and reward participation in the study, a £25 Amazon voucher was given to one randomly selected participant.

Stimuli. For this experiment, we created extended versions of a subset of the stimuli from Agres, et al. (2017). The original chord progressions from Agres, et al. (2017) were generated using a statistical model trained on a corpus of

chord progressions from the anthem section of 100 uplifting trance songs². For this research, we selected the three most enjoyed and three least enjoyed stimuli from the previous experiment (see Table 1), hereafter referred to as *Liked* and *Disliked* stimuli. The original sequences, taken from the first study, were expanded from 30 seconds to 120 seconds for the present experiment by adding a breakdown and a build-up section to each excerpt. The stimuli in Agres et al. (2017) were composed to span a degree of repetitiveness and complexity. To be consistent with the template song on which the original stimuli were based³, the breakdown section consisted of the same chords as the anthem, and the build-up section was comprised of only one chord (the first chord of the anthem). The resulting stimuli are available online⁴.

Table 1. The three most Liked and Disliked chord progressions from Agres et al. (2017), which were expanded for the current study. Note that the stimuli are listed in descending order of enjoyment, with the most Liked and most Disliked progressions in bold font.

Liked	Disliked
DBmGA–BmGABm	DDF#mF#m–F#mF#mDD
BmGDA–BmGDA	EmEmDD–EmEmEmEm
BmBmGG–BmBmGG	GGCC–CCGG

Procedure. An online listening study was conducted using Qualtrics⁵. On every trial, listeners heard a 2-min UT excerpt (including breakdown, build-up, and anthem sections). After listening to each stimulus, participants first rated their enjoyment of the excerpt on a Likert scale from 1-7 (where 1 represented ‘Not at all’ and 7 represented ‘Very much’). Then participants rated the state of absorption they achieved while listening to the excerpt, specifically, the extent to which they felt able to lose themselves in the music, e.g., “achieve a trance-like state of mind, become totally absorbed, or reach a state of flow.” This judgement was again made using a Likert scale from 1 to 7, with 1 representing ‘Not at all’ and 7 representing ‘Very much’.

At the end of the listening study, the participants were asked to complete a brief questionnaire about their trance music listening habits and expertise. In this questionnaire, the participants with experience *composing* trance pieces were asked to consider how their choice of chord progressions might affect the enjoyment or absorptive listening states of their audience, and the extent to which they take this into consideration when creating/producing a new piece of trance music. They were also asked how many years of experience they had as a DJ, composer, or music producer; how many hours per week they listen to UT music; and whether they have experienced trance-like absorptive flow states when listening to music.

² The corpus of 100 UT songs is available online at http://katagres.com/trance_experiment

³ Uplifting Trance Logic Pro X Template by Insight, DAW Templates, Germany

⁴ The stimuli are available online at http://katagres.com/trance_experiment

⁵ <http://qualtrics.com>

Results and Discussion

We tested all three hypotheses outlined in the Behavioural Experiment section. First, we tested the influence of chord structure on the ability of the listeners to reach AL states. Second, we examined the influence of chord structure in longer stimuli on listeners' enjoyment, and tested whether the results correspond to those in Agres et al (2017). Finally, the correlation between enjoyment and AL states was explored.

The results from the experiment confirm that there are meaningful relationships between harmonic structure and AL states, as well as subjective enjoyment and AL states. A mixed effects analysis, with AL states as the dependent variable and chord sequence as the independent variable, indicated a significant influence of chord sequence on AL states ($F = 2.73$, $p < .05$), providing evidence that harmonic structure does influence absorptive listening states. The chord progression corresponding to the highest average AL state rating was BmBmGG–BmBmGG, while that corresponding to the lowest average AL state rating was GGCC–CCGG. The semiotic structure of the latter (AABB–BBAA) violates expectations of musical form, as a change would be expected at the beginning of the second half of the sequence; this is not the case in the highest rated stimuli (AABB–AABB).

A second mixed effects analysis, with enjoyment ratings as the dependent variable and chord sequence as the independent variable, yielded a significant effect of chord progression ($F = 3.48$, $p < .01$), supporting the hypothesis that harmonic structure influences the enjoyment of UT excerpts. The three chord progressions that were most enjoyed in this listening study correspond to the most enjoyed (moderately complex) sequences from Agres et al (2017), although it should be noted that their ranked order of enjoyment differs.⁶ A mixed effects analysis was performed to test whether the most liked sequences from Agres et al (2017) correspond to the most enjoyed stimuli in the current study. In this analysis, enjoyment ratings (from the current study) were the dependent variable, liked/disliked stimuli (labels from Agres et al., 2017) were the independent variable, and participant was included as a random effect. This analysis provided significant evidence that the most liked stimuli from the previous work do indeed correspond to the most enjoyed in the current study ($R^2 = 0.59$, $F(1, 1) = 7.89$, $p < 0.01$), and confirms more generally the significant influence of harmonic structure on enjoyment in these longer, more ecologically valid stimuli.

Finally, the relationship between enjoyment and AL states was investigated. First, we examined which stimuli elicited the highest and lowest enjoyment and AL state ratings. As mentioned above, the sequence yielding the highest enjoyment rating of this study was BmBmGG–BmBmGG (avg rating = 4.68, std error = 0.25). Similarly, the stimulus with the highest AL state rating was also BmBmGG–BmBmGG (avg rating = 4.32, std error = 0.31). The stimulus with the lowest enjoyment rating was GGCC–CCGG (avg rating = 3.53, std error = 0.42), and again, the stimulus with the lowest AL state rating was GGCC–CCGG (avg rating = 3.00, std error = 0.37). A linear correlation confirmed that these two variables,

enjoyment and AL state, are significantly related ($\rho = 0.60$, $p < 0.001$). This relationship is depicted in Figure 1.

The results above indicate that chord progressions influence both AL states and enjoyment. In addition, the results confirm that enjoyment and AL states are correlated. In order to verify that the influence of chord progressions on absorptive states was not simply due to the influence of enjoyment, we tested whether the effect of chord structure on AL state ratings was mediated by enjoyment. A mediation analysis indicated that enjoyment did not have a significant mediating effect on AL states (ACME: $p=0.56$). That is, the influence of chord structure on AL states was not caused by the relationship between chord structure and enjoyment, confirming the significant effect of harmonic structure on absorptive listening states.

Results of the post-study questionnaire were also examined. Out of the 19 participants, 11 (or 58% of this expert group) indicated that they do carefully select chord progressions (when producing or composing trance tracks) to create a desired effect on the audience's enjoyment or absorption of the music. One of the participants, who was a producer with significant experience, reported that the chord progression "takes the listener on a journey", and that the chords need to be carefully chosen so that the music sounds engaging but not boring. Another respondent claimed that chord progressions are important for setting up expectations in the listener, and that delaying the resolution of the build-up creates a powerful harmonic tension in listeners, which is one of the most pleasurable aspects of trance listening. Although anecdotal, these responses indicate that composers of this genre do attempt to select chord progressions with the specific intention of guiding listeners' affective responses and states of consciousness. These subjective reports help support and confirm the important role of harmonic structure in trance music listening.

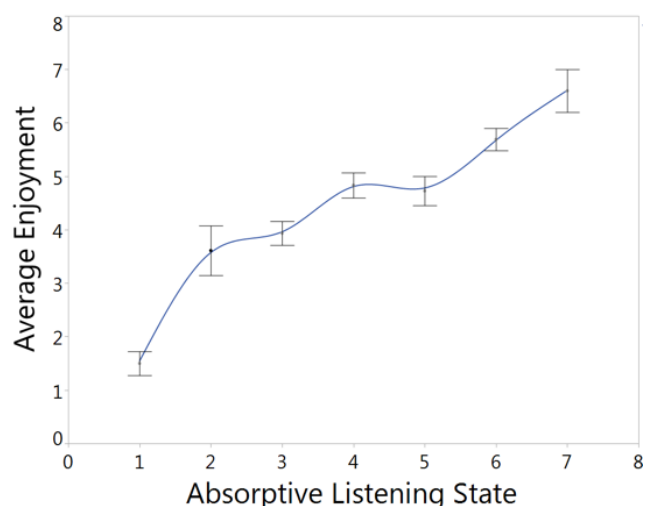


Figure 1. Average enjoyment ratings correlated with absorptive listening state ratings for all of the stimuli in the study. The error bars show the standard error from the mean.

⁶ Here, the progression with the highest enjoyment, BmBmGG–BmBmGG, is followed by BmGDA–BmGDA, and then by DBmGA–BmGABm, in order of average enjoyment rating.

Conclusion

We investigated three hypotheses in this study. First, we examined whether harmonic structure in UT music influences listeners' (self-reported) ability to reach absorptive listening states. Secondly, we investigated whether harmonic structure has an influence on listeners' enjoyment, further validating the results from Agres et al. (2017) by using longer, more ecologically valid musical excerpts. Finally, we hypothesised that the enjoyment of UT music and ability of listeners to reach absorptive states are associated.

The results of the experiment confirm each of the above hypotheses. More specifically, our findings indicate that the structure of chord progressions influences both listeners' enjoyment of the music and their sense of being absorbed in the music. UT excerpts that are most enjoyed are those which tend to elicit absorptive listening states in listeners.

Although our results also support a meaningful connection between harmonic structure and absorptive listening states, further research is warranted on this topic. In our experiment, four of the participants reported not having previously experienced absorptive listening states while listening to trance, which we assume may have influenced their AL state ratings to some extent. Furthermore, Haerlin (1998) has suggested that many listeners need around 13–15 minutes in order to fully reach AL states through auditory driving (in their case, drumming). Although subjective reports differ, this important point of giving the participants the necessary time to induce an absorptive listening state should be carefully considered in the future. Nevertheless, of the studies that explore which specific musical characteristics have an impact on trancing and absorptive listening states, the majority focus on rhythmic cues and auditory driving effects (Becker-Blease, 2004; Becker, 2012; Fachner, 2011; Neher, 1962; Trost et al., 2014). This is the first work, to the authors' knowledge, to confirm the meaningful connection between harmonic structure in UT music and absorptive listening states.

Acknowledgements. The authors would like to thank Associate Professor Louis Bigo from the Université Lille 3 for his help in creating the stimuli for this study. This research was partially supported by the Future and Emerging Technologies (FET) programme within the Seventh Framework Programme for Research of the European Commission, under FET grant number 610859, as well as the SRG ISTD 2017 129 grant.

References

Agres, K., Herremans, D., Bigo, L., & Conklin, D. (2017). Harmonic structure predicts the enjoyment of uplifting trance music. *Frontiers in psychology*, 7, 1999.

Agres, K., Bigo, L., Herremans, D., & Conklin, D. (2016). The effect of repetitive structure on enjoyment in uplifting trance music. In *Proceedings of the 14th International Conference for Music Perception and Cognition (ICMPC)*. San Francisco, CA. pp. 280-282.

Becker, J. (2012) Rhythmic entrainment and evolution. In J. Berger & G. Turov (Eds.), *Music, science, and the rhythmic brain: Cultural and clinical implications (1)*. New York: Routledge., pp. 49-72.

Becker-Blease, K. A. (2004) Dissociative states through new age and electronic trance music. *Journal of Trauma and Dissociation*, 5(2), pp. 89-100.

Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Perception & Psychophysics*, 8(5), 279-286.

Fachner, J. (2011). Time is the key—music and altered states of consciousness. In Cardena E. and Winkelmann M. (Eds.), *Altering consciousness: A multidisciplinary perspective, (1)* Connecticut, US: ABC-CLIO/Greenwood Publishing Group, pp. 355–376.

Gordon, J., & Gridley, M. C. (2013) Musical preferences as a function of stimulus complexity of piano jazz. *Creativity Research Journal*, 25(1), pp. 143-146.

Haerlin, P. (1998) Bewußtseinsverändernde Klanginstrumente in der Psychotherapie. *Psychotherapeut*, 43(4), pp. 238-242.

Herremans, D., & Chew, E. (2016). Tension ribbons: Quantifying and visualising tonal tension. Proceedings of the Second International Conference on Technologies for Music Notation and Representation (TENOR), Cambridge, UK.

Kakouri, K. (1965). Dionysiaka; Aspects of the Popular Thracian Religion of Today. *Trans. H. Colaclides*. Athens: G. C. Eleftheroudakis.

Kartomi, M. J. (1973) *Music and trance in central Java*. *Ethnomusicology*, 17(2), pp. 163-208.

Ludwig, A. (1966) Altered States of Consciousness. *Archives of General Psychiatry*, 15(3), pp. 225-234.

Madrid, A. L. (2008) *Nor-tec rifa!: Electronic dance music from Tijuana to the world*. New York: Oxford University Press.

Neher, A. (1962) A physiological explanation of unusual behavior in ceremonies involving drums. *Human Biology*, 34(2), pp. 151-160.

Orr, M. G., & Ohlsson, S. (2001) The relationship between musical complexity and liking in jazz and bluegrass. *Psychology of Music*, 29(2), pp. 108-127.

Silverman, J. (1968) A paradigm for the study of altered states of consciousness. *The British Journal of Psychiatry*, 114(515), pp. 1201-1218.

Trost, W., Frühholz, S., Schön, D., Labbé, C., Pichon, S., Grandjean, D., & Vuilleumier, P. (2014) Getting the beat: entrainment of brain activity by musical rhythm and pleasantness. *NeuroImage*, 103, pp. 55-6