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Groove Music and Pro-Sociality in Young Adults

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ABSTRACT

Music is a social phenomenon with communicative functions, using sensory, cognitive, motor and affective processes. This paper reports an empirical study with a goal of amalgamating and extending previous research surrounding groove in music, interpersonal synchrony and its socio-affective consequences, aiming to resolve whether moving to music with a specific level of groove impacts pro-sociality within dyads of young adults. The hypothesis was that dyads of young adults who have moved together to music with a high level of groove will be more pro-social with each other than those who have moved together to music with a low level of groove, but that the latter will be more pro-social than those who have not moved together to music at all. The hypothesis was partly supported by the results: the most enhanced pro-sociality was evident in dyads who had moved together to music with a high level of groove; however, dyads who had not moved to music at all were more pro-social than those who had moved to music with a low level of groove, suggesting that moving to music with a specific level of groove impacts pro-sociality.

1. INTRODUCTION

Music is central to much of human life (Rabinowitch & Meltzoff, 2017), and innate proclivity for music is suggested to be a result of the adaptive function of musical behaviour as a communication system (Darwin, 1871). Consequently, it is plausible that music evolved to become a facilitator of social bonding and pro-social cooperation (Kirschner & Tomasello, 2010; Tarr et al., 2014). Pro-sociality refers to behaviours and feelings incorporating empathetic and cooperative actions and manners (Eisenberg et al., 2007). This supports how music, and dance or movement to music, is often used in social settings and rituals (Kirschner & Tomasello, 2010).

Moving to music is related to human pleasure, and the impulse to move to music is common among all humans (Levitin et al, 2018; Witek et al, 2014). This impulse is associated with groove: the urge to move in response to music, accompanied by a positive affect associated with sensorimotor coupling (Janata et al., 2012). Groove is a common cause of entrainment (Witek et al., 2015), which can be defined as a phenomenon where two or more rhythmic processes interact and eventually connect within a common phase or periodicity (Clayton et al., 2004). Theories of groove encompass how music can compel humans to move in synchrony with its beat and coordinate movements with others spontaneously (Zentner & Eerola, 2010). There are numerous studies that link entrainment and synchrony of movement to increased pro-sociality in humans. Kirschner and Tomasello (2010) propose that music's efficiency in coordinating actions highlights shared intentions and encourages children to behave more pro-socially towards each other. Wiltermuth and Heath (2009) suggest that acting in synchrony with others can lead people to cooperate better, based on their investigation of walking both synchronously and asynchronously, and Rabinowitch and Meltzoff (2017) found that rhythmic interactions prominent in joint musical engagements and synchronized activity influenced pro-social behaviour between preschool peers.

The information above can be summarised by saying that groove is a common source of affective entrainment in music (Witek et al., 2015), and that synchrony and entrainment enhance skills that allow individuals to effectively build on cooperative motives (Valdesolo et al., 2010). Evidently, many studies focus on either correlation between levels of musical groove and movement response (Janata et al., 2012; Witek et al., 2014), or correlation between movement to music and pro-sociality (Kirschner & Tomasello, 2010; Zentner & Eerola, 2010). Additionally, many investigations focus on infants and young children (Cirelli et al., 2014; Kirschner & Tomasello, 2010; Rabinowitch & Meltzoff, 2017; Zentner & Eerola, 2010). This results in a gap in current research, which I aimed to address in the current study: whether moving to music with different levels of groove has an impact on pro-sociality within dyads of young adults.

It is hypothesised that dyads of young adults who have moved together to music with a high level of groove will be more pro-social with each other compared to those who have moved together to music with a low level of groove, but that the latter will be more pro-social than those who have not moved together to music at all.

2. METHOD

Participants. Eighteen UK university students participated in the current study (9 males and 9 females, mean age = 19.4 years, range = 18 to 21 years), all of whom were unpaid volunteers that consented to participation under the premise of an ethical agreement. Participants were recruited by invitations on social media pages. By a process of pseudo-randomization, participants within a dyad were recruited from different social media pages to assure unfamiliarity with each other; additionally, participants were asked whether they knew their partner on a general information questionnaire before the experiment began. Unfamiliarity within dyads controls for varying histories of cooperation which could affect pro-social tests. Dyads were mixed sex where possible (exceptions include an all-male dyad in condition group 1 and an all-female dyad in condition group 2, for logistical reasons). Kirschner and Tomasello (2010), when investigating how joint music making promotes pro-social behaviour, found that girls helped and cooperated more than boys, therefore having mixed sex dyads minimizes this effect. Participants completed a condensed version of the Goldsmiths Musical

Sophistication Index online before attending the experiment (Müllensiefen et al., 2014), of which the results also contributed to pseudo-randomization of dyads ensuring that, as much as possible, all dyads had roughly an equal amount of musical training (mean across dyads = 32.8, range of dyadic means = 30-34, range of full sample = 15-51). No volunteers were excluded from the experiment, and none were known to have any audio or visual impairment.

Design. The study utilized a sample of human participants, representative of Western young adults. Participants, in dyads, were pseudo-randomly assigned to different experimental conditions. The independent variable, the level of groove in the music being moved to, was manipulated by the experimenter; the dependent variable, enhanced pro-sociality (defined by the time taken to complete a joint-action task and the mean score from a reflection questionnaire), was measured as a continuous variable. The independent variable was defined based on justifications from a pilot survey and was manipulated by the assignment of dyads to one of three condition groups: 1) No Music, 2) Low Groove, 3) High Groove. The study followed an independent-measures design: dyads completed tasks in one condition only. This controlled for fatigue and practice effects, that may have confounded the results.

Materials and Stimuli. Musical stimuli used in the main experiment were derived from a pilot survey utilizing a sample of 12 UK University students, none of whom took part in the main experiment. The pilot sample was representative of the sample used in the main experiment (6 males and 6 females, M = 19.3 years, range = 18 to 20 years). The pilot survey involved participants listening to 15 excerpts of music, each lasting 15 seconds. The excerpts were uniformly presented to every participant, played through laptop speakers at a constant volume in an isolated location, via an MP3 file that was exported from Sibelius. Between each excerpt, there was a 15 second break from music, allowing completion of the paper questionnaire provided, rating on a 7-point scale how much the music made them want to move to it, and how easy they found it to tap along to a beat. Having completed the listening task, all participants completed a Musical Training questionnaire and a Music Preferences questionnaire.

The pilot survey was influenced by several studies. Janata et al. stated that "a broad range of musical excerpts can be appraised reliably for the degree of perceived groove…and that high-groove stimuli elicit spontaneous rhythmic movement" (2012: 54). They also recognized that different individuals may define the term "groove" differently, so asked them to use their own personal definition of "the groove" in making judgements. Building on this, the term "groove" was avoided altogether, and instead participants were asked related questions. The excerpts were originally composed for the study, to avoid complications with familiarity, and composed for an ensemble of a Bass Drum, Double Bass and Piano. More than three concurrent voices could have led to additional distractions based on voice entries (Huron, 2001). Genres used were influenced by the results from Janata et al. (2012, 62) and current findings supported their use, with a soul style being rated highest for groove. Other criteria included drive (determined by bass drum regularity), swing and syncopation level, and tempo. Witek et al. (2014) suggest that music associated with groove is often characterised by rhythmic complexity in the form of syncopation, but that too much syncopation can have the opposite effect. This relates also to feelings of pleasure and is supported by Senn et al. (2017). According to Keil (1987), music should be slightly 'out of time' if it is to be socially appreciated and personally involving; however, the stimuli used were perfectly 'in time' due to the nature of a Sibelius performance. While this may be considered unhelpful for the experiment, Keil's theory on participatory discrepancies has been countered by Butterfield (2010), who claims that micro-timing deviations are not required to give a sense of groove. Merker et al. stated that "the structural key to the entrainment capacity…is the simple device of an isochronous pulse" (2009: 4) and Hannon and Trehub (2005) add that western listeners have considerable difficulty with patterns that are not isochronous.

Results of the pilot survey were obtained by calculating an average score for each excerpt and finding the total from all participants for each of the excerpts. Figure 1 shows the results.

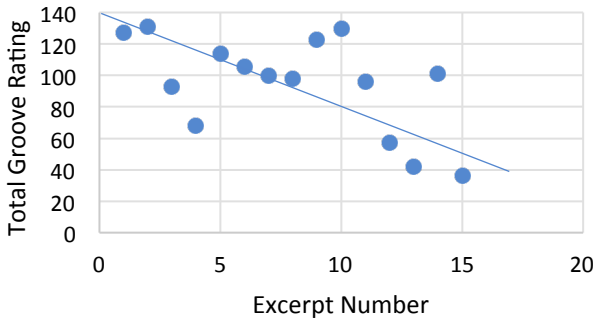

Figure 1. Pilot Test Results.

The final chosen excerpts to be extended for use in the main experiment were: 1, 2, and 10 for the high groove condition, and 12, 13, and 15 for the low groove condition. The blue line on the graph in Figure 1 shows the expectations of the results, and this informed prediction allowed for a quasi-randomization of stimuli presentation to avoid fatigue or pattern predictions. Excerpts 9, 10 and 14 seemed too high, yet 3 and 4 seemed too low. Reasons for these divergences include that excerpt 9 was the first to be heard on the audio file, therefore participants may have been unsure of how highly to rate it. An example excerpt would have been useful to avoid this issue. Excerpt 10 was in a dance music style, which increased in drive gradually throughout, therefore a rating over time may have resulted differently. Other differences were mainly accounted for by looking at individual results and how they related to STOMP questionnaire results and musical training.

Musical stimuli used in the main experiment were three 30 second excerpts considered to be high groove, and three 30 second excerpts considered to be low groove. All excerpts were newly composed for the present study. Music was presented in a uniform style to all dyads: an MP3 audio file exported from Sibelius, played through laptop speakers at a

constant volume, in a room big enough to safely move around in. Instrumentation was an ensemble of Bass Drum, Double Bass and Piano. Although the stimuli were not completely ecologically valid regarding genre and instrumentation, they give a high level of experimental control. The first test for pro-sociality, a joint-action task, involved a wooden labyrinth board, 40.5cm x 35cm x 3cm in size, in which a marble could travel along a predetermined path from start to finish when the board was moved. The labyrinth board was an appropriate size for participants in a dyad to hold opposite ends, meaning that success required dynamic detection and response by participants to the movements of their partner. Difficulty was determined by informal pilot testing of 4 labyrinths. The second test for pro-sociality, the reflection questionnaire, was inspired by Valdesolo et al. (2010) and is a partner evaluation using 7-point rating scales with questions assessing connectedness and the development of such feelings throughout the task. Movement to music was assessed by qualitative observational coding (see Results section for details).

Procedure. The experiment was carried out in a large, quiet room in the Durham University Music Department. Each dyad was tested separately. Participants were first given an information sheet with instructions and a brief description of the research project that did not reveal the hypothesis. They were then given a chance to ask any questions. Following this, participants gave informed consent and completed the general information questionnaire. Dyads were pre-assigned to a condition group, of which they were unaware. The groups were 1) No Music, 2) Low Groove, 3) High Groove. Groups 2 and 3 were predicted to be asynchronous movement and synchronous movement groups respectively, due to the levels of groove that the music had. This is likely due to the rhythmic properties of the excerpts used in each condition group, such as the complex beat and lack of pulse in the low groove music making it difficult for Western listeners to move in synchrony (Hannon & Trehub, 2005).

Dyads of group 1 began the timed Labyrinth task immediately after completing the general information questionnaire. They were under instructions not to speak whilst doing so but could communicate through gestural actions if necessary. This isolated the movement aspect of the study, making coding clearer. Following this, both participants completed a reflection questionnaire and were given a written debrief explaining the purpose of the study.

After their completion of the general information questionnaire, group 2 dyads were played the low groove excerpts and asked to move in a way they felt inclined to whilst facing their partner. Tapping a nearby table, head nodding, clapping, and stepping were given by the experimenter as suggestions. Rationale for not enforcing a simple tapping task, such as those used in other movement synchrony studies (Launay et al., 2013; Levitin et al., 2018; Rabinowitch et al., 2015), is that entrainment behaviour relating to sociality includes various bodily movements (Zentner & Eerola, 2010). Additionally, Janata et al. (2012) highlight that "dampening of positive emotional experience" could occur with the inhibitory instructions to "tap a single finger isochronously with a beat". Immediately after the excerpts were heard, dyads of group 2 were given the timed labyrinth task, followed by a reflection questionnaire and written debrief. Group 3 dyads followed the same procedure as those in group 2, only they were played high groove musical excerpts.

3. RESULTS

Results of the joint-action task are shown in Table 1 and Figure 2. Young adults who moved together to music with a high level of groove completed the task quicker (M = 8.09s), denoting success and enhanced pro-sociality, when compared to those who moved together to music with a low level of groove (M = 14.36s) and those who had not moved together to music (M = 12.28s). Dyads who had not moved together to music were more pro-social than those who moved together to low groove music, however, suggesting that perhaps it is only after moving to music with a high level of groove that pro-social behaviours are significantly enhanced between a dyad of young adults.

Results of reflection questionnaires are shown in Table 2 and Figure 3. Young adults from the high groove condition displayed a greater self-rated enhancement of pro-sociality (M = 6.70) than those from the low groove condition (M = 4.18) and those who had not moved together to music at all (M = 4.22). Dyads who had not moved together to music at all had a slightly higher average score than those from the low groove condition, supporting the results from the joint-action task. Ranges of results in both pro-sociality tests across all conditions are similar.

In addition to the above measures of enhanced pro-sociality, qualitative observational analysis that coded movement into a set of main themes was carried out by the experimenter during the movement to music phase for groups 2 and 3. Themes that evolved arose from commonalities such as the part of the body being moved, and whether movements were synchronous or asynchronous. Findings are shown in Table 3. More exertive and synchronous movements were observed in responses to the high groove music than to the low groove music, suggesting that exertion and synchrony levels affect pro-sociality.

Table 1. Time Taken for Dyads to Complete the Labyrinth Joint-Action Task

Condition Group	Mean Time (s)	Median Time (s)	Range of Times (s)
1 (No Music)	12.28	12.49	3.72
2 (Low Groove)	14.36	13.64	2.51
3 (High Groove)	8.09	8.02	1.98

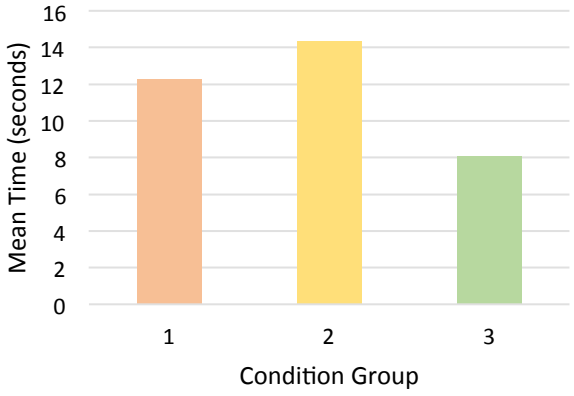

Figure 2. Mean time taken for the dyads within each condition group to complete the labyrinth pro-social joint-action task.

Table 2. Reflection Questionnaire Scores.[1]

Condition Group	Mean Score	Median Score	Range of Score
1 (No Music)	4.22	4.09	2.30
2 (Low Groove)	4.18	3.96	2.95
3 (High Groove)	6.70	6.25	2.10

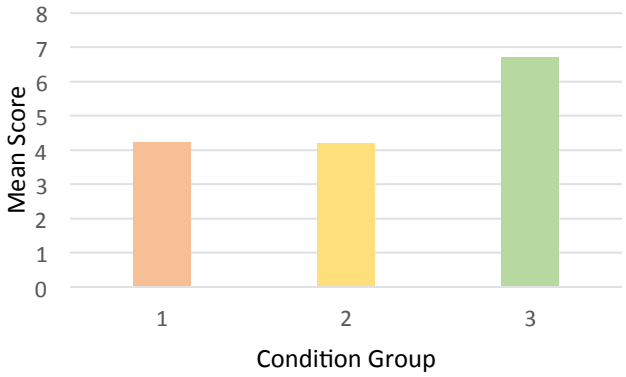

Figure 3. Average scores that individual participants in each condition group rated their pro-sociality in the reflection questionnaire. The difference between mean results for condition groups 1 and 2 is more marginal in this test of pro-sociality than in the joint-action task results; however the overall pattern remains.

Table 3. Qualitative Observational Coding of Movement of Individuals and Dyads Within Condition Groups 2 and 3 When Moving to Excerpts of Music Prior to Pro-Social Tests.

Participant N$^{o.}$	Condition Group	Movement Most Commonly Observed	Status of Synchrony
3	2	Finger Tapping	An isochronous beat was kept but asynchronous to both partner and music.
4	2	Finger Tapping	A non-isochronous beat was kept but asynchronous to both partner and music.
9	2	Clapping	An isochronous beat was kept but asynchronous to both partner and music.
10	2	Clapping and Shoulder Movement	A non-isochronous beat was kept, synchronous to music but asynchronous to partner.
15	2	Hand Tapping and Head Nodding	A non-isochronous beat was kept, synchronous to music but asynchronous to partner.
16	2	Hand Tapping	A non-isochronous beat was kept, asynchronous to both partner and music.
5	3	Stepping side-to-side	Synchronous with both partner and music.
6	3	Stepping side-to-side	Synchronous with both partner and music.
11	3	Stepping side-to-side with clapping	Synchronous with both partner and music.
12	3	Stepping side-to-side with clapping	Synchronous with both partner and music.
17	3	Clapping	Synchronous with both partner and music.
18	3	Stepping side-to-side with clapping	Synchronous with both partner and music.

[1] 7 is the maximum score for self-rated enhanced pro-sociality. Individual ratings for each question were calculated to give a mean score, and the mean of these scores were calculated for each condition group.

4. DISCUSSION

It was hypothesised that dyads of young adults who had moved together to music with a high level of groove would consequently be more pro-social than those who had moved together to music with a low level of groove; in turn, it was predicted that those who moved with low groove music would be more pro-social than those who had not moved together to music at all. Results showed that those in the high groove condition had more enhanced pro-sociality than those in the low groove condition and those who had not moved together to music at all, supporting the first part of the hypothesis. Dyads who had not moved together to music at all, however, were more pro-social than those in the low groove condition, which contradicts the second part of the hypothesis.

Proximate Mechanisms: Results in context of related literature. Rationale for enhanced pro-sociality being most evident in the high groove music condition, followed by the non-musical condition, and lastly by the low groove music condition, is likely related to several associated psychological mechanisms which have evolved for both music-specific and non-musical purposes.

The "chameleon effect" (Chartrand & Bargh, 1999) refers to nonconscious behavioural mimicry that occurs when human partners communicate, the outcome being one's behaviour unintentionally changing to match that of the Other. Behavioural coordination is related to empathy (ibid) which is a key manner of pro-sociality, and a positive correlation exists between the amount of entrainment and nonconscious mimicry within a dyad and enhanced pro-sociality (Kirschner & Tomasello, 2010). Within this experiment, condition groups 2 and 3 were predicted to result in asynchronous and synchronous movements respectively, likely due to the complex beat and lack of pulse in the low groove music making it difficult to move to. This prediction was subsequently supported by the analysis of movements (Table 3), meaning that a positive trend also occurs between the level of groove that music has, and the amount of entrainment and nonconscious mimicry a dyad display when moving to music. These two trends combined account for how this study supports the first part of the hypothesis. Cirelli et al. (2014) and Marsh et al. (2009) substantiate this, suggesting that ease of induced entrainment corresponds with pro-sociality. It is ease of induced entrainment that is provided by high groove music, in turn allowing the "chameleon effect" to function. Whilst it is possible that this mechanism worked on the premise of interpersonal mimicry independent of musical triggers (Hove & Risen, 2009), Launay et al. (2013) suggest that when synchronizing with sound alone, perceived synchronization can still play a role in affiliative behaviour.

Self-Other merging following interpersonal synchrony (Tarr et al., 2014) is another related psychological mechanism. Valdesolo et al. (2010) suggest that "moving together in time serves as a cooperation-enhancing mechanism, binding individuals together into adaptive units of reciprocal exchange". This point is reliant again on high groove music facilitating synchronous movement within dyads. Wiltermuth and Heath (2009) state that a periodic pulse, of which is evident in the high groove music excerpts only, is essential for ease of bodily synchronisation which in turn produces positive emotions, weakening boundaries between self and Other and resulting in feelings of collective delight that enable groups to remain cohesive.

Feelings of collective delight in relation to social cohesion (Wiltermuth & Heath, 2009) also relate to a third mechanism: collective spirit and shared intentionality. Valdesolo et al. (2010) suggest that coordinated actions have the capacity to induce a collective spirit and that close synchrony allows the productive channelling of said spirit. It is likely that by moving together in synchrony with collective spirit, participants in condition group 3 could maintain a constant audio-visual representation of a collective intention which transferred to the joint-action task and reflection questionnaire: high groove music facilitates the coordinating of actions that highlights shared intentions and encourages pro-sociality.

A final mechanism is the release of endorphins during exertive rhythmic activities. The Endogenous Opioid System and endorphins are essential to the neurohormonal foundations of pro-sociality in music-related movement (Tarr et al., 2014). Opioids are released in response to low levels of muscular movement including active listening (Dunbar et al., 2012), and the expressive timings and syncopation present in high groove music force active listening (Levitin et al., 2018). This supports the hypothesis and results of group 3 showing that high groove music most enhanced pro-sociality; however, it does not account for why the non-musical condition group were more pro-social than group 2.

Suggestions for Further Research. Reasons for results not supporting the second part of the hypothesis could depend on several issues. Firstly, regarding data analysis, no inferential statistics were calculated, therefore the significance of results cannot be completely interpreted. In a future replication of this study, an ANOVA test could be valuable to support that the effect is not random; however, it would not necessarily support the results of the second part of the hypothesis as the difference in means is already in the non-predicted direction. The likelihood of random effects is also aided by the small size and narrow demographics of the sample. A future replication would benefit from more dyads in each condition group, with a suggested amount of at least 25 (Rabinowitch & Meltzoff, 2017). The sample used was Western, educated, industrialized, rich and democratic. This is problematic as this sub-group has been shown to be diverse from other cultures in many senses (Henrich et al., 2010; Savage et al., 2015); however, when testing for beat-perception related variables, it is wise to focus on a single sub-culture to avoid additional biases. Such biases can arise from the tendency for Western adults to stretch or shrink the component rhythmic intervals toward an isochronous framework even when target patterns have noticeable deviations from isochrony (Hannon & Trehub, 2005).

Confounding variables relating to the sample could also have affected results, including the possibility of some participants being more experienced at completing labyrinth puzzles than others, and being more coordinated through other practices such as sports. Numerous participants may have also been overgenerous with their reflection ratings, highlighting a limit of the study's design; self-rating questionnaires invite biased responses.

Other issues with the design include the data analysis technique used for movement observations. Qualitative analysis allows an in-depth study of behaviours, but it does not provide causal evidence. Whilst this was not an issue in this study because other testing was done alongside the qualitative analysis, observation by only one experimenter during the live experiment still presents subjectivity issues. Ideally, there would be use of motion capture technology and inter-coder agreement to avoid bias.

A final problem that accompanies the study of young adults is that all participants were fully aware of their experimental settings and therefore may have not acted in a completely natural manner.

CONCLUSION

The goal of this study was to amalgamate and extend previous research surrounding groove music, interpersonal synchrony and the socio-affective consequences of it, aiming to resolve whether moving to music with a specific level of groove would impact pro-sociality within dyads of young adults. Findings suggest that the level of groove that music has can significantly affect the way that a dyad move, with high groove music resulting in much more exertive, entrained and synchronous actions than low groove music. Dyads who had moved together to music with a high level of groove were accordingly more pro-social afterwards than both those who had moved together to music with a low level of groove, and those who had not moved to music at all. Dyads who had not moved to music at all were more pro-social than those who had moved to music with a low level of groove, rendering the hypothesis partly supported, suggesting that moving to music with a specific level of groove does impact pro-sociality.

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