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Fostering Creativity in Music Lessons through the Implementation of Body Movement

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Lennart Schubert

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[*s3338959*]

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Department of Psychology
University of Groningen
Examiner/Daily supervisor:
Dr. Lisette de Jonge-Hoekstra

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Abstract

The aim of the current pilot study was to develop a further understanding behind the research question: How does the implementation of body movement in music lessons and thus variability in movement relate to creativity as well as subjective 4E musical creativity and experience? Correspondingly, a longitudinal experiment was conducted in which three participants particpated in four innovative Kine-Musical Performance (KiMuPe) lessons and following improvisations on a weekly basis. The improvisation sessions were recorded, coded according to an adapted version of the Micro-Developmental Coding Framework of Creativity by Kupers et al. (2018) and then the participants' amount as well as variability of movement was analyzed with OpenPose. To measure 4E musical creativity and experience a new questionnaire was created on the basis of the definitions and examples of the Embodied, Enactive, Embedded, and Extended dynamics of musical creativity by Van der Schyff et al. (2018). As this was an explorative pilot study, we did not formulate hypotheses. The findings revealed that our creativity coding was not predictive of variability of movement. However, we did find significant relations between average variability in movement and the Embodied dynamics of musical creativity as well as the full model of the 4E subscales. These results point to promising insights into the relationship between the 4E dynamics of musical creativity and variability of movement. Therefore, extending research on how musical creativity evolves using complex dynamical systems approaches and KiMuPe while taking 4E dynamics into account might result in culturally relevant results that have a major impact on how music is taught.

Keywords: musical creativity, 4E cognition, dynamical systems theory, embodied cognition, music education, improvisation

Fostering Creativity in Music Lessons through the Implementation of Body Movement

Throughout our history, humankind has been fascinated by music as a creative expression of culture. According to the archaeological record the oldest known musical instrument appeared approximately 40,000 years ago (Killin, 2018). From this, archaeologists infer musical artefacts and activities must have been part of human culture for a longer time than their records can account for. In 2021, the global recorded consumption of music products in the music market grew by 18,5%, 523 million people have a subscription to music streaming services, and the Top 10 songs of that year have been streamed 17,6 billion times in total (International Federation of the Phonographic Industry, 2022). What is more, empirical research has shown that music is important in emotion regulation, primary interactions between infants and caregivers, therapy and healing, the development of personal, social, and cultural identities, the expression of complex aesthetic relationships and collective performance (DeNora, 2000; McPherson et al., 2012; Small, 1998). Thus, as music appears to be a central aspect of human cultural and creative expression, gaining a better grasp of what constitutes musical creativity may lead to a clearer comprehension of creativity in general. Moreover, because of an overall agreement in music education that creativity is a central aspect of music making and important in the development of a musical identity (Burnhard, 2012), there is a need to enhance our understanding about it. The goal of this paper is to add to that effort by examining musical creativity in light of current embodied cognitive science research and on build the exploration of Van der Schyff and colleagues (2018) of the connection between 4E cognition and dynamical systems theory.

Creativity is a complex phenomenon which has been researched in a large variety of domains and activities (Kaufmann & Sternberg, 2006; Sternberg, 1988). In the past, the literature on creativity has been dominated by the framework of Rhodes “The 4P’s of Creativity” (1961) which dissects creativity on the level of the person, product, process, and

press. On the level of the person, creativity was often researched as a characteristic of one's personality as well as its relation to intelligence. Furthermore, it was deemed useful to assess creativity by evaluating its products, such as musical compositions. On the level of the process, research has aimed to understand how creative behavior unfolds in real-time. Lastly, Rhodes (1961) describes creativity as socially embedded which he indicates by the term "Press". However, as researchers acknowledged the insufficiency of that framework (Lubart, 2017), the need to develop a new approach that delves into the relationships between the 4P's arose. Nowadays we recognize creativity as an emergent and distributed process (Sawyer, 1999, 2003). This means that, instead of having a specific endpoint, creativity develops over time, whereby creative actions depend on the history of previous creative actions. We also acknowledge that creativity occurs in a larger social context, whereby any given creative action can change following actions of other actors. Based on that, Kupers and colleagues (2018) developed a Generic Micro-Developmental Coding Framework of Creativity that aims to measure creativity on a real-time level which we will use in this study to investigate the unfolding of creativity.

Building on this, Van der Schyff and his colleagues (2018) created a framework for musical creativity based on the dynamical systems theory and Menary's "4E Cognition" (2010) which describes cognition as distributed across the entire body of a living system and its surrounding environment. From that perspective establishing new body movements into musical practice through this novel approach could increase variability within a musician-instrument system. Elicited by the idea that body movements in music lessons could therefore foster creativity, Dr. Luc Nijs developed the Kine-Musical Performance (KiMuPe)-Approach. KiMuPe includes free and structured body movements in musical practice. It aims to promote creativity by opening new meaningful relationships in the musician-instrument system through challenging existing body movement patterns with the instrument. In the following

sections, I will further explain creativity from a 4E and dynamic systems theory perspective, the KiMuPe approach, and how these are combined and empirically investigated in the current explorative pilot study.

Connecting 4E Cognition to Musical Creativity

The concept of 4E cognition describes the mind as not being distinct from the body (Menary, 2010; Newen et al., 2018). Accordingly, the mind would incorporate the body and its environmental context through Embodied, Embedded, Enactive, and Extended cognition. These are not discrete but entail overlap even though these four types of cognition capture diverse perspectives on cognitive phenomena.

Embodied cognition assumes that body and brain are inherently connected due to having evolved together and it refers to the contribution of the body to cognitive processes as well as vice versa (Menary, 2010; Newen et al., 2018). In regard to musical creativity, Van der Schyff and colleagues (2018) define the Embodied dynamics of creative musical action as the motor and affective aspects that are connected to the simultaneous production and experience of musical sound by the musician. Take the example of a bass player who is given a novel instrument with the intention to improvise with it. Van der Schyff et al. (2018) argue that improvising would be inherently related to how the body interacts with the instrument, how the instrument "responds" to the performer's intentions as well as how the performer's entire body resonates and feels during the improvisation with the novel instrument. Therefore, they conclude that new relationships that extend over instrument, body, brain, and the emerging sonic world would develop through this embodied form of action-as-perception (Nöe, 2004).

Embedded cognition captures the coupling of physical and socio-cultural systems (Malinin, 2019). Influenced by Gibson's (1966, 1979) ecological theory it defines perception as direct without the need for mental representation and proposes the sensitivity for action

opportunities (i.e., affordances) as the main driver for environmental perception. These affordances depend upon the unique bodily capabilities of the actors and the possibilities for action provided by the environment. Consequently, the Embedded dynamics of musical creativity are defined by how musicians adaptively position themselves in relation to the physical and socio-cultural system, that is the musical environment, in which these musicians express their musical creativity (Van der Schyff et al., 2018). For instance, imagine a more experienced guitarist and a novice guitarist are asked to play their instrument. According to Menin and Schiavio (2012) findings the expert player will have a larger variety of affordances to choose from compared to the novice guitarist. Van der Schyff et al. (2018) argue that these affordances may emerge from the dynamic relationship between the embodied musical agent and the history of action-as-perception with her or his instrument.

Enactive cognition entails the idea that the purpose of cognition is action and through meaningful action we gain understanding of our environment allowing us to thrive within it (Varela et al., 1974, Varela et al., 2016; Thompson & Stapleton, 2009; Menary, 2010;). In musical creativity these processes manifest in various contexts. One such context is improvisation in which the patterns of musical activity and the goals are less specified, and meaning is actively derived through the ongoing interaction between musicians (e.g., Borgo, 2007; Schiavio et al., 2019). According to Van der Schyff et al. (2018) the Enactive dynamics of musical creativity are associated to the performer's relational autonomy. This refers to the subtleties of how distinctive musical identities and environments emerge through the self-organizing activity of musical agents. Moreover, it relates to how these processes continuously shape relational and creative constraints. For example, in improvisation the individuality of musical identities must be adaptively renegotiated among the performers to successfully foster a harmonious musical environment. To keep the music interesting the performers must modulate each other's behavior according to the constraints of their fellow

performers and musical theory. As specified by Van der Schyff et al. (2018), this is achieved through an awareness of the music as it develops over time, the musicians' changing feelings and intentions and the way these are communicated through forms of shared forms of visual, auditory, and bodily signaling.

Lastly, Extended cognition portrays thinking as distributed beyond the body (Clark & Chalmers, 1998). It argues that the mind is shaped by both biological and non-biological features of the environment (Hutto & Myin, 2013; Clark, 2008). Sutton (2010) suggests that cognitive integration is ongoing, reciprocal, and dynamic. The confines of the mind would be open-ended and flexible in which cognitive processes manifest over time including the body, resources in the environment, and other people thus also influenced by socio-cultural practices. With this as the fundament, Van der Schyff et al. (2018) associate the Extended dynamics of the musical creativity to how musicians cognitively integrate their instruments and other technologies. Moreover, they add it also relates to how musicians adopt different social tasks related to their performance with fellow musicians. To illustrate this in a real-world example, Van der Schyff and his colleagues (2018) mention a percussionist improvising on an arrangement of instruments. Correspondingly, to arrange multiple instruments in a way that constitutes a harmonious song, these instruments must be cognitively integrated into the musician's cognitive ecology. Specifically, by "offloading" his or her musical expertise to the instruments that are "functionally coupled" with the broader musical environment, the musician can produce a song.

Ultimately, Van der Schyff and colleagues (2018) conceptualize a theoretical bridge between 4E cognition and the dynamical systems theory. Accordingly, 4E Cognition is based on the processes that occur over several time scales at the level of the individual and the collective in which living systems self-organize and autonomously enact dynamic patterns of behavior that are significant for existence and well-being. Thus, self-organizing agents may

have an effect and assist in sustaining behavioral dynamics if the system can be considered as functional. Maturana and Varela (1980, 1992) defined the outcome of such processes as larger-scale, multi-organism systems.

Complex Dynamical Systems and Musical Creativity

Complex dynamical systems have different components at multiple scales of a system that interact and coordinate through self-organization (e.g., Kelso, 1995; Smith & Thelen, 2003; Van Geert, 1998; Van Orden et al., 2003). The continuous interaction of these self-organizing components creates global patterns through which novel patterns can emerge. Therefore, complex dynamical systems can be regarded as greater than the sum of its parts. However, the global patterns which emerge from these interactions can be relatively stable in a network of connected elements, withstanding perturbations within certain limits. Typical of a stable pattern is the tendency to be attracted to a specific state within a system to which it continuously returns to (Kunnen & Van Geert, 2012). This state is called an attractor state.

From the perspective of DST, learning and development in general appear to be equivalent to a transition in which the attractor layout of the system is changed by cognitive agents or their environment (Schöner & Kelso, 1988). Specifically, the continuous self-organizing patterns align differently which leads to a new layout, creating new possibilities for a range of phase relations. Ahead of such a phase transition signalizing an upcoming transitional period is an increase in variability which is defined as the amount of fluctuation within a system over time (Kunnen & Van Geert, 2012). This increase can be triggered by perturbations caused by living systems interacting with their environment which consequently can lead the system to move around or even temporarily out of the attractor basin. Related to musical terms, this could mean that perturbing a musician's system in the form of an intervention could change how she interacts with her musical instrument, potentially increasing the variability of what the musician plays.

In physical education Storey and Butler (2013) point out that disturbance, attractors, affordances, and attunement may all be studied on an individual level to comprehend how internal self-organization relates to movement choices and how modification of the environment will prioritize some potentialities over others. Accordingly, it could be beneficial to understand how the inclusion of body movement in music lessons can cause a perturbation of a musicians' attractor leading to an increase in variability in the complex dynamical system that is the relationship between the musician and her instrument. Moreover, it could be interesting to assess whether the potential increase in variability could be related to an increase in musical creativity. In that case for example, integrating body movements in music lessons through KiMuPe could provoke a guitar player who is drawn to melodies in minor keys to play unfamiliar melodies in major keys. So, with the increase of variability, the variety of the musician's affordances (i.e., action possibilities) for how she uses and understands her instrument would increase, enabling more musical creativity.

Body Movement in musical practice and KiMuPe

In his chapter of the book "Becoming Musicians" Nijs (2019) points out the strong tradition of teaching how to play an instrument that has been passed down for generations and its problems associated with the master-apprentice model in view of the pedagogical developments. Consequently, research has revealed that this model is mostly characterized by a teacher-centered approach that focuses on technique to support reproduction corrected by verbal feedback and aural modelling, self-regulation, and individualistic artistic voice (e.g., McPherson & Welch, 2012; Nijs, 2019). However, nowadays we know about the importance of collaborative learning for effective leaning and teaching (Ferguson-Patrick & Jolliffe, 2018). Thus, Nijs (2019) calls out for a reconsideration and innovation in instrumental music teaching which includes the promotion of artistic creation (e.g., composition, improvisation), student initiative (e.g., choice of repertoire), informal learning, and collaborative exercises.

Furthermore, the body should be integrated in the instrumental learning process. Accordingly, this could be achieved through the promotion of bodily engagement taking personal style and instrumental gestures into consideration. Moreover, deliberate, and expressive movement in response to music should be incentivized by teachers. This would create an empowering learning environment for instrument learners which also fosters intrinsic motivation.

The basis of this idea stems from the theory of embodied music cognition which entails an evidence-based understanding about the influence of bodily senses and movement on the perception, feeling, experience, and comprehension of music (Lesaffre et al., 2017). Correspondingly, musical meaning is a result of embodied interaction with music through engagement and direct participation with the musical environment (Dourish, 2004; Leman, 2016). Nijs (2019) extends that through such an interaction a sound-movement-intention connection is created that transforms sound patterns into a meaningful musical experience. The transformation process, also called enactment, arises due to the association of sound patterns (e.g, melody, chord sequence, etc.) with movement patterns (e.g., energy, direction, etc.) which can trigger intentional states (e.g., emotions) that are coupled with these sound patterns. Such a coupling is facilitated as movement and sound patterns are both time-based (Sievers et al., 2013). This all connects to the idea of the 4E dynamics of musical creativity posited by Van der Schyff et al. (2018).

On this basis, Nijs developed a new approach to instrumental music teaching called Kine-Musical Performance (KiMuPe) reconsidering the role of the body and body movement in music lessons. Accordingly, KiMuPe integrates an “education of the body” which transcends the instrumentalist approach by the traditionalist master-apprentice model of instrumental music teaching and learning (Nijs, n.d.a). KiMuPe aims to develop the inner musician by integrating movement to realize the incorporation of the body with the musical instrument. Consequently, the premises of KiMuPe are built on the continuous involvement of

the body with the musical instrument, the development of the inner musician, a bottom-up approach which incentivizes exploration and experimentation as well as a gradual increase of complexity and exercising the performing body.

Current Research and Research Question

In this study, the innovative approach of KiMuPe is used as to assess whether the inclusion of movement in music lessons can promote creativity by opening new meaningful relationships in the musician-instrument system. According to Kunnen and Van Geert (2012), perturbations can increase variability in complex dynamical systems, opening the chance for a phase transition. Hence, this could be achieved by challenging attractor states of body movement patterns with the instrument proving the potential of the implementation of body movement in music lessons (Nijs, 2019). Moreover, assuming the mind incorporates the body and its environmental context through Embodied, Enactive, Embedded, and Extended cognition (Menary, 2010; Newen et al., 2018), thus far, no empirical study has been conducted that attempts to measure and directly link 4E Cognition to subjective musical creativity, and musical experience. Consequently, it could be valuable to find out whether these concepts are applicable to a creative musical context.

To test this, we conducted an experiment throughout four lesson sessions in which our participants were asked to do various KiMuPe body-movement exercises with their instrument. At the end of each lesson, improvisation sessions to two backing tracks were held serving to track changes of movement and creativity over the course of the experiment. The research question of this study is: How does the implementation of body movement in music lessons relate to creativity as well as subjective 4E musical creativity and experience? Specifically, we researched whether variability in movement potentially caused by the perturbation of KiMuPe can be explained by 1) creativity scores based on a customized generic micro-developmental coding framework of creativity by Kupers et al. (2018) and 2)

ratings of subjective 4E musical creativity and experience on a new questionnaire based on the definitions of Van der Schyff et al. (2018). As this was an explorative pilot study, we refrained from formulating hypotheses.

Methods

Participants

The participants of our study consisted of a convenience sample in which three advanced amateur guitarists were recruited from the personal network of Kevin Phan, a fellow master student working on a similar research topic. The age of our participants ranged between 20 and 26 years, with an age average of 23.33. Participant 1 indicated having taught himself how to play the guitar and having gained more than ten years of experience. He practices each day of the week, improvising 40% of the time in proportion to practicing. Participant 2 also indicated being mostly a self-taught guitarist but having taken some private lessons. He indicated having between five and ten years of experience. Also, he practices five days a week for about one hour per session, improvising 60% of the time in proportion to practicing. Participant 3 stated having two to five years of experience, having taken guitar lessons from a family member. She practices approximately three times a week for about an hour, improvising about 26% of the time in proportion to practicing.

Materials

The KiMuPe-exercises for the lessons and homework were based on an unpublished manual written by Dr. Nijs (n.d.b) for students of the flute. These exercises were adapted for guitar players by my fellow researcher Kevin Phan (2022) in the context of an internship. In the first session, we asked the participants in the introduction questionnaire for some demographic data and their background as well as experience with the guitar. After each of the four sessions, the participants were asked to fill out a feedback- and self-constructed 4E, and flow questionnaire. The feedback- and flow questionnaire served to give insight into the

participants opinion on the sessions and their flow experience for the internship and study of my fellow researcher. Due to the lack of subjective 4E musical creativity and experience related self-report inventories for questionnaires, we had to create a new one derived from the definitions and examples of the Embodied, Enactive, Embedded, and Extended dynamics of musical creativity by Van der Schyff et al. (2018) [Appendix A]. The questionnaire consisted of four blocks with a varying number of items. In each questionnaire the participants were asked to indicate their level of agreement on a Likert scale (from 1 for strong disagreement to 7 for strong agreement).

The videos of the experiments were filmed with a Logitech C925e Pro Full HD Webcam and a GoPro Hero 4. The sound recordings were recorded with two Tascam DRL-10 in diagonally opposite corners of the laboratory as well as a Rode NT1-A studio microphone that was connected to a Steinberg UR22 mkII USB audio interface. For the lessons, we asked the participants to bring their own acoustic guitar with a strap to facilitate movement while playing. For the improvisation, the participants had two backing tracks to play on which were “Horizon” by Daft Punk and “Easy Groove Guitar Backing Track Jam in C minor | #SZBT 246” by Sebastien Zunino. The videos of the experiments were cut in iMovie; the sound and the videos were merged with Adobe Premier. For the creativity coding, the Generic Micro-Developmental Coding Framework of Creativity by Kupers et al. (2018) and ELAN were utilized. As an annotation tool for audio and video recordings, ELAN allows its users an unlimited number of textual annotations connected to and synchronized with the media timeline (ELAN, n.d.). To analyze movement, OpenPose, a real-time multi-person system, was used as it can detect human body, hand, facial, and foot key points on single images (Hidalgo et al., n.d.). RStudio was used to create timeseries from the OpenPose output. For final adjustments in the motion analysis of OpenPose, we used Microsoft Excel. Eventually,

the analysis of the data was done in RStudio using the lme4 package (v.1.1-15 Bates et al., 2015).

Procedure

KiMuPe Sessions

After the study protocol was approved by the Ethical Committee of Psychology of the University of Groningen and the recruitment of the participants was done, my fellow researcher and I constructed lesson plans according to the unpublished KiMuPe-manual by Dr. Nijs (n.d.b). As part of his internship, Kevin Phan, my fellow researcher adapted the exercises that were meant for flute players to guitar players. At the beginning of the first session, we introduced our participants to KiMuPe with a pre-written rehearsed text (Appendix B). Our goal was to make sure we do not disclose too much information about our research while giving them an idea about the structure of the lessons and familiarizing them to the unconventional yet innovative approach. Following that, the participants were invited to introduce themselves and their musical background. Subsequently, the first QR-code entailing the introduction questionnaire was shown on PowerPoint and the participants were asked to sign the informed consent. The warm-up exercises started without the guitar. At first, we asked the participants to walk through the room and shake hands when their paths cross in three different modes (Appendix B). The following warm-up exercise “Saying Hello through Music” contained the same elements and modes but adding the guitar. Next, my fellow researcher who acted as the instructor of the lessons introduced the first exercise “Planking with your Instrument”. While making unfamiliar body movements, we reinforced the participants to keep on playing their guitar. The last exercise for the first session was called “Stepping to the Music” in which the participants were required to play their guitar in three different movement modes (Appendix B). At first, the participants and the instructor improvised to “Horizon” by Daft Punk followed by “Easy Groove Guitar Backing Track Jam

in C minor | #SZBT 246" by Sebastien Zunino. To wrap the first session up, the instructor presented the homework for the participants. The access to the feedback and 4E-questionnaire was then projected as a QR-code on a PowerPoint slide onto a screen.

In the second session, we welcomed the participants and started with an informal talk about their experiences, motivation, best moments, and goals playing the guitar. This was followed by two warm-up exercises from last session "Saying Hello through Music". After a short break we presented the first new exercise called "Side to Side". The last exercise of the second lesson was called "Stick & Rope" (Appendix B for further explanation of the exercises). Subsequently, the participants improvised to the same backing tracks of the previous improvisation. Eventually, we had a general discussion about the session and asked the participants again to fill out the feedback and 4E-questionnaire.

Unfortunately, the third session started with a cancellation of the most experienced participant due to sickness. Nevertheless, we proceeded with the lessons and started with a homework review. The first warm-up exercise was to play air guitar to "Dazed and Confused" by Led Zeppelin. Next, we conducted a new version of the exercise "Stepping to the Music". Continuing after a break, the following exercise was again "Side to Side" with the addition of "Front to back" (Appendix B). This was followed by the improvisation to the backing tracks of the previous lessons. In the end, we had a short discussion about the lesson and asked them to fill out the feedback and 4E-questionnaire again.

In the last session the second most experienced guitarist had to cancel due to sickness. Like the previous session, we started by playing some air guitar to "Europa (Earth's Cry Heaven's Smile)" by Santa and "Felt Like Playing Guitar and Not Singing" by Two Feet. Subsequently, the exercise "Stepping to the Music" was performed again. For the break, we invited our participants to play freely and sing if they wanted to. The last exercise was a repetition of "Stick & Rope" from the second session. Before improvising at the end, we

reminded the participants again of the movement exercises. Then the participants improvised again to the same backing tracks as in the previous lessons. Finally, the participants filled in the feedback and 4E-questionnaire one last time.

Data Preparation

Over the course of the four sessions, the recordings of the lessons and improvisations were made separately with the equipment mentioned in the material section and stored on my external drive and the local drive of the university. The recordings of the improvisation sessions were cut and merged with the sound. Subsequently, ELAN templates with the videos and sound were created for each session and then utilized for creativity coding according to the adapted version of the Micro-Developmental Coding Framework of Creativity by Kupers et al. (2018) [Table 1]. Then, the data of the questionnaires were downloaded from Qualtrics, organized for the analysis, and stored on the local drive of the university.

Creativity Coding

For coding the creative actions of our participants, my fellow researcher and I chose the Generic Micro-Developmental Coding Framework of Creativity by Kupers et al. (2018) which we adapted to the context of our study (Table 1). The basis of their framework is the definition of creativity by Plucker et al. (2004) who describes creativity as "the interaction among aptitude, process and environment by which an individual or group produces a perceptible product that is both novel and useful as defined in a certain social context" (p.90). Thus, the framework focuses on dissecting the two essential components of creativity, namely novelty and appropriateness. In a three-step process, Kupers et al. (2018) describe how to develop a coding system that measures creativity on a real-time level to analyze how creative processes unfold in the here and now.

The first step in evaluating creativity from moment to moment is to figure out what those "moments" or units of analysis are (Kupers et al., 2018). For this study, we decided to

define our unit of analysis as the backing tracks our participants played over. Thus, each backing track was used as one unit of analysis which we also refer to as a turn.

In the following step we had to determine how to code for novelty. The first category of the coding scheme for this experiment was defined as the repetition of harmony and rhythm, so repeating the same notes given by the backing track. The following category of novelty was defined as a small variation in rhythm and harmony including new strum patterns and accentuations. Large variations in rhythm and harmony, so new notes within key and scale, were determined as the third category. Lastly, the turn with only novel elements was defined as a new idea in the form of new notes outside of the main key, but within scale. Each of these categories were given a code from zero to three.

The last step in developing the micro-developmental coding framework of creativity is to outline how to code for appropriateness. The core of this dimension is determining how well the current turn fits into the larger task or assignment (Kupers et al., 2018). Accordingly, we defined the lowest category of appropriateness as off-beat and dissonant guitar playing as this would not fit into the larger task of improving to the backing track. Categories two and three are correspondingly gradations of rhythmic and harmonious guitar playing. Finally, the last category is defined by playing the guitar rhythmically on-beat and harmonious, so playing key and scale fitting notes. Like the novelty dimension, each of these categories had a code from zero to three.

After finding consensus, my fellow researcher and I coded eight turns cooperatively on ELAN. Following that we coded the rest of the turns separately to assess inter-rater reliability and compared the coding afterwards. As the inter-rater reliability was only 10%, we went through all the turns in which we had varying coding to find consensus on how to code them.

Table 1

The Adapted Version of the Micro-Developmental Coding Framework of Creativity by Kupers et al. (2018)

Level	Appropriateness	Novelty
0	Off-beat and dissonant	Repetition of harmony and rhythm - repeating the same notes given by the backing track
1	Rhythmically mostly on-beat, mostly harmonious	Small variation in rhythm and harmony - new strum pattern, accentuation
2	Rhythmically on-beat, mostly harmonious	Large variation rhythm and harmony - new notes within key and scale
3	Rhythmically on-beat & harmonious (playing key and scale fitting notes)	New Idea - new notes outside of the main key, but within scale (blues notes)

Motion Analysis

As the script processing the OpenPose-data had difficulties in consistently recognizing the participants and assigning them to only one color throughout the time series, we had to go over all of them individually to identify the color changes for each participant. This problem mostly arose when participants left the frame and came back after a while. The color switches in the time series were then documented in Microsoft Excel as overview to correct them in OpenPose. Following that, dr. Lisette de Jonge-Hoekstra, our supervisor, helped us to analyze the movement with OpenPose. Hereby, for the amount of movement she calculated the sum change in pixel coordinates and divided this by the total amount of frames during an improvisation part. The average change in pixel-distance from frame to frame is hence the amount of movement. The variability is the standard deviation of all pixel-distance changes

during an improvisation part. These measure of amount and variability of movement were then included in the final data set.

Analysis

Due to performing a longitudinal study in which multiple data points are from the same participants, we performed a mixed model analysis. First, we conducted a linear mixed effects analysis to determine how the two subscales of creativity—novelty and appropriateness—relate to movement variability. We had random intercepts for participants as well as random slopes for the novelty and appropriateness effects as random effects. Subsequently, the association between movement variability and the four subscales of the 4E-questionnaire—Embodied, Embedded, Enactive, and Extended—was then examined also using a linear mixed effects analysis. For each of the four subscales, we had random intercepts as well as random effects for the participants. The *p*-values were derived by likelihood ratio tests comparing the entire model with the effect in question to the model without the effect in question. This was done with a hierarchical multilevel analysis. Due to the small sample size, the outcomes of the linear mixed effects analyses should be regarded with caution.

Results

At first, to investigate the relation between variability in movement and creativity, a model with both session and novelty as fixed and random factor was compared to a baseline model containing only the predictor session, a fixed and random factor considering each participants movement per session. The model with both session and novelty as a fixed and random factor did not predict average variability of movement better than the baseline model with session alone, $\chi^2(4) = 1.96$, $p = 0.74$. Moreover, the Akaike Information Criterion (AIC) was higher for the model with both session and novelty as a fixed and random factor (AIC = 50.96) than the baseline model (AIC = 44.92), indicating a better model fit for the model including only Session.

Subsequently, a model with session and appropriateness as fixed and random factor was compared to the baseline model. The model with session and appropriateness did not statistically predict average variability of movement better than the baseline model with session alone, $\chi^2(4) = 1.33$, $p = 0.86$. Also, it had a worse model fit (AIC=51.58) compared the baseline model (AIC = 44.92).

Even though the information of the previous models proved to not add any explanatory power to average variability of movement, another model was constructed merging all the elements of the previous models to test whether the combination of information of all the models would have statistical significance over model with session and novelty and the model with session and appropriateness. In comparison to the model with session and novelty, the model with session, novelty, and appropriateness as fixed and random factor was not predictive of average variability of movement, $\chi^2(4) = 0.002$, $p = 1$. Correspondingly, it also had a worse model fit (AIC = 58.95) than the model with session and novelty (AIC = 50.96). Equivalently, in comparison to the model containing session and appropriateness, the model including all of the elements also did not predict average variability of movement neither, $\chi^2(4) = 0.63$, $p = 0.96$. Accordingly, all of the models did not contain any information explanatory for average variability of movement.

In the following analysis, to investigate the relation between subjective 4E musical creativity and experience and average variability of movement, the items of each block of the 4E questionnaire were averaged for every participant so that each block had one average score. Subsequently, a model with session and embodied (averaged scores of the block "Embodied Experience") as fixed and random factor was compared to baseline model containing only session. Compared to the baseline model, model with session and embodied did predict average variability of movement significantly better, $\chi^2(4) = 17.57$, $p < .01$. Hereby, higher scores of embodied went together with less variability of movement, lowering

it about 0.84 ± 2.19 (standard errors) as seen in Figure 1. Also, model with session and embodied as a fixed and random factor (AIC = 35.35) has an improved model fit compared to the baseline model (AIC = 44.92). Moving on, a model containing session and embedded (averaged scores of the block "Embedded Experience") as fixed and random factor was compared to the baseline model. This revealed a statistically non-significant result, $\chi^2(4) = 2.26$, $p = 0.67$, and a worse model fit (AIC = 50.65) [Figure 2] compared to the baseline model (AIC = 44.92). Similarly, a model containing session and enactive (averaged scores of the block "Enactive Experience") as a fixed and random factor, $\chi^2(4) = 0.78$, $p = 0.94$, and a model with session and extended (averaged scores of the block "Extended Experience") as a fixed and random factor, $\chi^2(4) = 0.08$, $p = 0.99$, comparing them to the baseline model did not result in statistically significant results. Also, the model with session and enactive (AIC = 52.13) [Figure 3] and the model with session and extended (AIC = 52.83) [Figure 4] had a worse model fit than the baseline model (AIC = 44.92). Thus, except from the model with session and embodied as fixed and random factor, the other models containing the subscales of the 4E questionnaire did not predict average variability of movement better than the baseline model with session alone.

Nevertheless, a model combining all the subscales of the 4E questionnaire embodied, embedded, enactive, and extended with session as a fixed and random factor compared to the model with embodied and session exhibited a statistically significant result, $\chi^2(16) = 102.12$, $p < .01$. Also, the model fit of the model combining all the subscales of the 4E questionnaire (AIC = -42.77) showed a great difference from the baseline model (AIC = 44.92). So, even though of the subscales of the 4E questionnaire only the model with embodied and session as a fixed and random factor had a significant result, combining all of them into one model with session predicts average variability of movement significantly better than the model with embodied and session.

Figure 1

Embodied plotted against average variability of movement

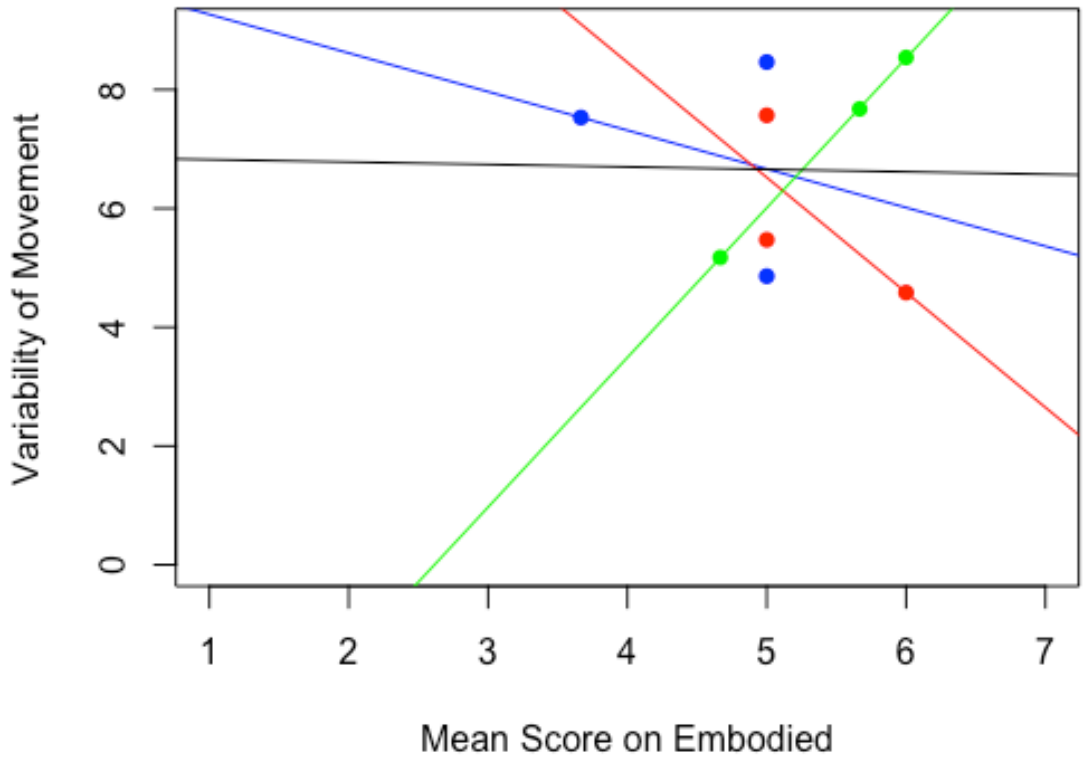


Figure 2

Embedded plotted against average variability of movement

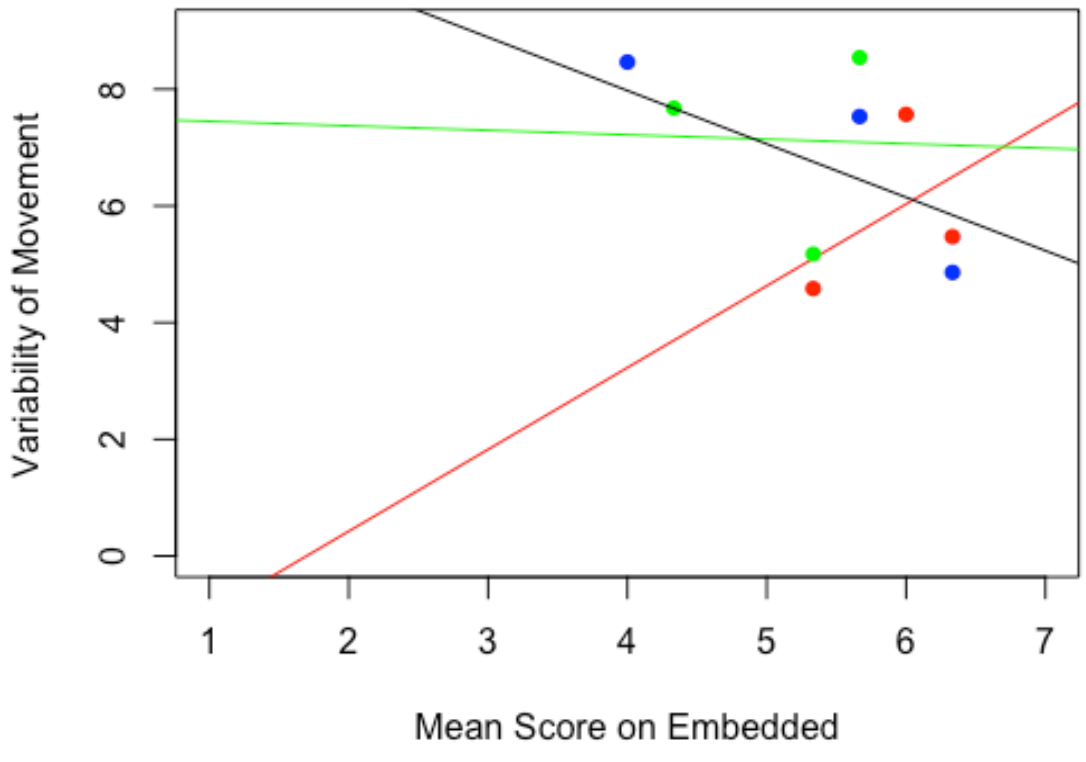


Figure 3

Enactive plotted against average variability of movement

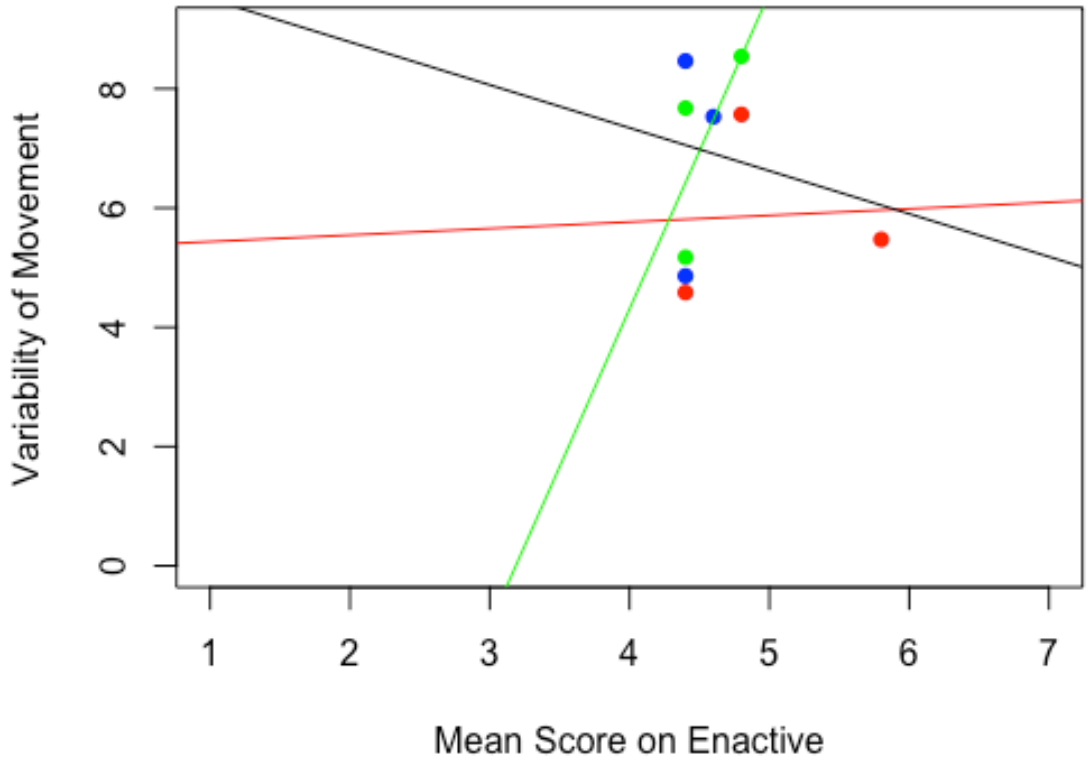
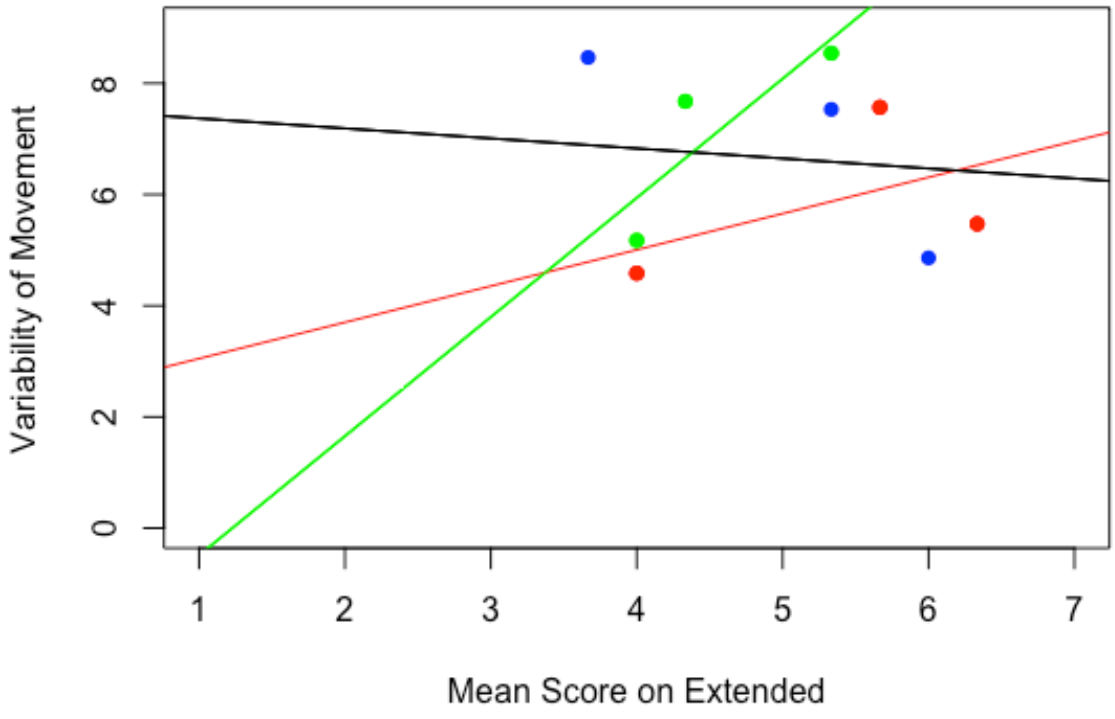


Figure 4

Extended plotted against average variability of movement



Discussion

The main aim of this pilot study was to explore the potential effects of structured body movements in musical practice through the innovative KiMuPe approach on musical creativity in light of current embodied cognitive science research. Also, this study aimed to expand on Van der Schyff and colleagues' (2018) examination of the relationship between 4E cognition and dynamical systems theory. Therefore, we examined whether 1) creativity scores based on an adapted Generic Micro-Developmental Coding Framework of Creativity by Kupers et al. (2018) and 2) ratings of subjective 4E musical creativity and experience on a new questionnaire based on the definitions of Van der Schyff et al. (2018) could explain average variability of movement during KiMuPe lessons.

The first part of the analysis comparing average appropriateness and novelty scores of each participant with the baseline model resulted in statistically non-significant findings. Accordingly, we were not able to find statistical evidence indicating a relationship between average variability of movement and average appropriateness and novelty scores beyond chance. Thus, the coding of the adapted Micro-Developmental Coding Framework of Creativity by Kupers et al. (2018) [Table 1] did not appear to be predictive of average variability of movement. This means that the data we obtained does not imply that average variability of movement relates to an increase nor decrease of creativity following the application of KiMuPe exercises.

There are multiple reasons which could explain this result. One of those reasons could be that the coding was based on student judgements with moderate levels of expertise in the field of music education and music creativity. Although the adapted coding system encompassed specified decision rules for the segmentation of the data in units of analysis and for the coding of those units to create a quantitative measure of creativity (Kupers et al., 2018), it still contains qualitative aspects of the Consensual Assessment Technique. This

technique is founded on the notion that the collective judgement of experts in a field is the best indicator of the creativity of a work of art, a theory, a research project, or any other artefact (Baer & McKool, 2009). Regarding this study, the qualitative aspects of this technique are not only manifested in the construction of the coding system, but also in judging which actions are to be coded as more creative than others. Therefore, expert judges are required for such a technique to work and effectively capture the unfolding of creativity, as their judgment is considered as the most valid assessment of the creativity of an idea or invention in any discipline (Baer & McKool, 2009). Researchers have consistently reported high inter-rater reliabilities among expert judges, with values typically ranging from .70 to .90 (e.g., Amabile, 1996; Baer, 1993, 1997; Conti et al., 1996; Hennessey, 1994). Additionally, Amabile (1966) showed that the greater the number of judges independently evaluating a product, the higher the overall inter-rater reliability correlations will be. Accordingly, the appropriate number of expert judges would be just over 10. In the case of this study, the inter-rater reliability was only 10% between two researchers with moderate levels of expertise. Thus, the coding cannot be considered as a reliable estimate of the participants' musical creativity.

Another reason potentially explaining the statistically non-significant results for creativity could be social interaction dynamics. According to research on social interaction and coordination, interaction dynamics can change depending on group and context, and these differences can have a significant impact on the results of social engagement (Dideriksen et al., 2020; Fusaroli et al., 2012; Fusaroli & Tylén, 2016). In terms of creativity, groups who work together frequently surpass individuals who do the task alone (Larey & Paulus, 1999; Taylor et al., 1958; Wahn et al., 2017). This can occur when group members successfully combine their diverse perspectives, offer unique approaches, or encourage one another to break out of cognitive fixations (Rosenberg et al., 2022). However, group members might

impede each other's creativity because social interaction can bias or disrupt group members' search processes, limiting their ability to fulfill their creative potential (Diehl & Stroebe, 1987; Kohn & Smith, 2011; Lencioni, 2002; Pauhus et al., 1993). In an experimental study, Rosenberg, and colleagues (2022) researched how social interaction dynamics affect collective creativity. In a computer game, they instructed pairs of participants to create “beautiful and interesting” designs by moving tiles on a large touchscreen. Pairs with a single dominant member tended to explore fewer parts of the solution space, remain there longer, and develop more but less creative designs on average. Contrary to that, pairs that alternated every time a tile was moved, tended to explore more, spent less time in the area section of the solution space, and produced fewer but more creative forms. These findings suggest that naturally emerging interactions styles influence how group creativity develops. In the case of the current study, the introduction questionnaire gives insight into potential problems that could have affected social interaction dynamics negatively and thus, inhibited creativity. Participant 3 mentioned having insecurities and having the ambition to learn how to feel more comfortable and confident. Similarly, participant 2 noted being in his “head” too much, holding himself back from improving and wanting to learn how to comfortably play with others. In contrast, participant 1 who is the most experienced guitarist appeared to be more confident as he indicated having nothing holding him back from developing musically. Thus, it is possible that the varying levels in experience and confidence led to an imbalance in social interaction dynamics limiting the participants’ ability to fulfill their creative potential.

The second part of the analysis focused on ratings of subjective 4E musical creativity and experience on a new questionnaire based on the definitions of Van der Schyff et al. (2018). Here, we found a significant result for the model containing embodied and session compared to the model with only session as well as for the model combining all the subscales of the 4E questionnaire and session compared to the model with embodied and session. Thus,

both of these models appear to be predictive of average variability of movement with the latter being seemingly more predictive of average variability of movement. Accordingly, some ratings of the participants on the questionnaire appear to be related to the average variability of their movements following the application of KiMuPe exercises.

On that basis, we cautiously can make some inferences. According to the definition of Van der Schyff et al. (2018) and the subjective ratings of our participants, these results indicate a relationship between average variability of movement and the Embodied dynamics of musical creativity. However, against our expectations, the significant result for the model containing embodied and session showed a negative relationship between average variability of movement and the mean score on embodied (Figure 1). Upon closer inspection of Figure 1, we can observe that the regression lines of two of the three participants show negative trends. Only the regression line of one of the participants shows a perfect positive linear relationship between mean score on embodied and average variability of movement. Consequently, the integration of structured body movement through KiMuPe in music lessons according to Nijs (2019) apparently had varying effects on the participants. These varying effects could potentially be explained by the different levels of experience and the amount of improvisation in proportion to practicing. For example, the participant with the perfect positive linear relationship is also participant 2 with five to ten years of experience, improvising 60% of the time in proportion to practicing, which is the most of all of the participants. Contrary to that, participant 3 with the least experience and the lowest amount of time spent improvising in proportion to practicing with only about 26%, had the steepest negative regression line of all the participants. Participant 3 who had the most experience with ten or more years improvising 40% of the time in proportion to practicing, however, had also a negative regression line. So, maybe the negative relationship reflects the varying skills that are needed in improvisation among the participants.

In line with this, participants of KiMuPe appear to require a "base level" of expertise before they can gain from the implementation of structured body movement. Therefore, if the goal of KiMuPe is to perturb the attractor states of its participants through structured body movement to attain variability and therefore creative development, not only the amount variability but especially the structure of variability should be considered (Van Dijk, 2014). The use of nonlinear dynamics tools has shown that some variability patterns are better than others for promoting development, specifically a variability pattern called “pink noise” (Kello et al., 2007). This pattern implies a complex nested pattern across time scales which potentially has a coordinative function. Another important aspect to consider in this regard is intra-individual variability which are behavioral differences within behavior at different points in time (Van Geert & Van Dijk, 2002). Thus, it is essential to perceive development not as a linear, but as a phenomenon in which individual context and its fluctuations over time should be considered. Consequently, KiMuPe may have perturbed the least experienced musician too much and the most experienced musician too little.

Besides, the full model containing session and all of the subscales appeared to be significantly related to average variability of movement. This is surprising as the rest of the subscales of the 4E questionnaire were statistically non-significant. Also, the large difference between the models in AIC stood out showing the model with all of the subscales being a large improvement compared to the model with only embodied and session. Thus, the participants ratings of their subjective 4E musical creativity and experience on the questionnaire was able to explain a large portion of average variability of movement in our study. Possibly there could have been overlap between the 4E subscales leading to a significant result when they are combined. However, a completely satisfactory explanation for this result is lacking. Also, as this was a self-constructed questionnaire these results should be treated with caution. Consequently, before applying too much weight on these results, the

study should be replicated and an assessment of the items quality through item-rest correlations should be conducted.

Limitations and Further Research

Our study has several limitations of which we will address the most significant ones. First, one of the main shortcomings of this pilot study was the nonprofessional level of expertise in musical creativity and education with which the coding framework of Kupers et al. (2018) was adapted and utilized. Consequently, our coding had an inter-rater reliability of only 10% making it an inadequate measure of musical creativity. Therefore, experts from the field of musical creativity and music education should be consulted to construct a more detailed coding system due to the validity of their assessment of what constitutes musical creativity (Baer & McKool, 2009). Moreover, the units of analysis should not be an entire backing track, but they should be segmented into different phrases of a backing track. In this way, the coding could provide more information on how musical creativity unfolds over the course of the sessions. Additionally, not just two but multiple experts should code the recordings as this increases the overall inter-rater reliability correlations (Amabile, 1966).

Secondly, the instructor of the KiMuPe lessons was also my fellow researcher. Thus, it is important to consider the possibility of modelling effects which could have had a significant confounding effect on the performance of our participants. So, the participants could have been unwittingly influenced to perform similar to my fellow researcher acting as the instructor. Nevertheless, we tried to minimize the demand characteristics which could give the participants a clue of purpose of the research by not mentioning words like creativity, flow, etc. However, another important aspect to mention then is the possibility of expectancy effects which could also backfire, especially because the experiments were conducted with a convenience sample consisting of acquaintances of my fellow researcher. Thus, it is possible that due to knowing each other in beforehand, the expectations of my fellow researcher could

have had a confounding effect on the behavior of the participants. Consequently, to prevent potential modeling and expectancy effects, other researchers conducting similar experiments in the future should refrain from having an active role in the instruction of the lessons.

Thirdly, the sample size of this study was small with only three participants. Therefore, it is difficult to determine whether the results of this study can constitute a true finding. Moreover, the sample consisted of a heterogeneous group of guitarists with varying levels of expertise and experience. As some participants were more experienced than others, it opened the possibility for social interaction dynamics inhibiting the creative potential of some of the participants. So, studying the effect of structured body movement on musical creativity could be conducted more effectively by recruiting a more homogeneous group of musicians with similar levels of expertise and experience. Nevertheless, if further research with this framework is conducted, researchers should still control for the social interaction dynamics and how they potentially stimulate or inhibit the musical creativity of the participants.

Also, the usage of narrow measures of variability of movement and creativity coding limiting the amount of data that can be assessed for variability in the musician-instrument system and creativity is another limitation. For further research, we could gain a better understanding of how specific constraints give rise to dynamics of musical creativity by means of dynamic systems theory methods measuring changes in musicians' movements (Van der Schyff et al., 2018). For this to materialize, this pilot study showed that a framework and research instruments are needed that can provide a broader data set. For example, Núnez and Alessandroni (2021) proposed a longitudinal, mixed, and multilevel methodological framework which also takes the shift in developmental and cognitive psychology towards the 4E approach into account. This would be needed to further understand triadic interactions, for example between music teachers, students, and their instrument. Also, this framework could assist in comprehending the musical structuring of these triadic interactions. Thus, the

purpose of this framework is to describe the dynamics of musical organization of triadic interactions, and its development over different time scales. Accordingly, this framework could give us a more in-depth insight into the musician-instrument system in interaction with the instructor of the KiMuPe exercises. Furthermore, Daikoku (2018) pointed out temporal (i.e., rhythm) and spectral (i.e., pitch) features in musical creativity and improvisation. In his study, he provided a hierarchical implicit-learning model that merges temporal and spectral aspects in musical improvisation and creativity which can be supported interdisciplinary using behavioral, neurophysiological, and information-theoretic approaches. To analyze these aspects within the longitudinal, mixed, and multilevel methodological framework of Núnez and Alessandroni (2021), Cross Wavelet Spectral Analysis could be used. This is a non-linear time series method which has found widespread application in geological sciences and physiology (Walton et al., 2015). Cross Wavelet Spectral Analysis has the benefit of revealing similar periodicities in behavioral coordination at nested time scales by recognizing local microscale structures (e.g., note) inside global macroscale patterns (e.g., chorus) (Schmidt et al., 2014). Thus, one of the advantages of Cross Wavelet Analysis is its ability to establish how movement coordination relates to the musical context's shorter- and longer-term temporal structure and phrasing (Walton et al., 2015). The dynamics that occur as a result of the musical context can then be compared using the movement coordination. Hence, it is recommendable to use the framework of Núnez and Alessandroni (2021) together with the Cross Wavelet Spectral Analysis and the background knowledge of the temporal and spectral feature in musical creativity (Daikoku, 2018) to answer the research question of this pilot study. All of this could provide an information-richer data set than the one in the present pilot study.

Besides, other lessons can be derived from this pilot study in regard to materials. The equipment in the experiments could have been set up in a more suitable way for the motion

analysis. As aforementioned, OpenPose continuously mixed up the participants movement when someone left the frame and reentered after a while. Hence, we had to manually check the time series and adjust the mistakes OpenPose made. Having a 360° camera could potentially alleviate software issues misidentifying the participants and confusing their movement. Also, attaching microphones to the guitars of the participants could assist in distinguishing between what the participants played.

Conclusion

All things considered, this pilot study tested and provided a framework on how to conduct research in musical creativity using the innovative approach of KiMuPe (Nijs, n.d.a), an adapted version of the Generic Micro-Developmental Coding Framework of Creativity (Kupers et al., 2018), complex dynamic system theory methods, motion analysis and a self-constructed subjective 4E musical creativity and experience based on Van der Schyff et al. (2018). Although our creativity coding was not predictive of average variability of movement, the 4E questionnaire revealed significant relations between average variability in movement and the Embodied dynamics of musical creativity as well as the full model of the 4E subscales. Consequently, this study provides promising insights into the connection between the 4E dynamics of musical creativity and variability of movement. In conclusion, expanding research on how musical creativity unfolds using complex dynamical systems methods and KiMuPe while considering 4E dynamics could lead to important findings which can profoundly influence the way music is being taught.

References

Amabile, T. M. (1996). *Creativity in context: update to the social psychology of creativity*. Westview Press.

Baer, J. (1993). *Creativity and divergent thinking: a task-specific approach*. L. Erlbaum Associates.

Baer, J. (1997). Gender differences in the effects of anticipated evaluation on creativity. *Creativity Research Journal*, *10*(1), 25–31. https://doi.org/10.1207/s15326934crj1001_3

Baer, J., & McKool, S. S. (2009). Handbook of research on assessment technologies, methods, and applications in higher education. In *Assessing creativity using the consensual assessment technique* (pp. 65–77). essay, Information Science Reference. https://doi.org/10.4018/978-1-60566-667-9.ch004

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). "Fitting Linear Mixed-Effects Models Using lme4." *Journal of Statistical Software*, **67**(1), 1–48. doi: 10.18637/jss.v067.i01.

Borgo, D. (2007). *Sync or swarm: improvising music in a complex age*. Continuum.

Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis*, *58*(1), 7–19.

Clark, A. (2008). *Supersizing the mind: Embodiment, action, and cognitive extension* (Ser. Philosophy of mind). Oxford University Press.

Conti, R., Coon, H., & Amabile, T. M. (1996). Evidence to support the componential model of creativity: Secondary analyses of three studies. *Creativity Research Journal*, *9*(4), 385–389. https://doi.org/10.1207/s15326934crj0904_9

Daikoku, T. (2018). Musical creativity and depth of implicit knowledge: spectral and temporal individualities in improvisation. *Frontiers in Computational Neuroscience*, *12*, 89–89. https://doi.org/10.3389/fncom.2018.00089

DeNora, T. (2000). *Music in everyday life*. Cambridge University Press.

Dideriksen, C., Christiansen, M. H., Tylén, K., Dingemanse, M., & Fusaroli, R. (2020). Quantifying the interplay of conversational devices in building mutual understanding. In *PsyArXiv*. https://doi.org/10.31234/osf.io/a5r74

Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: toward the solution of a riddle. *Journal of Personality and Social Psychology*, *53*(3), 497–509. https://doi.org/10.1037/0022-3514.53.3.497

Dourish, P. (2004). *Where the action is: The foundations of embodied interaction.* MIT Press

ELAN. (n.d.). The Language Archive. Retrieved July 14, 2022, from https://archive.mpi.nl/tla/elan

Ferguson-Patrick, K., & Jolliffe, W. (2018). *Cooperative learning for intercultural classrooms: case studies for inclusive pedagogy*. Routledge.

Fusaroli, R., Bahrami, B., Olsen, K., Roepstorff, A., Rees, G., Frith, C., & Tylén, K. (2012). Coming to terms: quantifying the benefits of linguistic coordination. *Psychological Science*, *23*(8), 931–939. https://doi.org/10.1177/0956797612436816

Fusaroli, R., & Tylén, K. (2016). Investigating conversational dynamics: interactive alignment, interpersonal synergy, and collective task performance. *Cognitive Science*, *40*(1), 145–171. https://doi.org/10.1111/cogs.12251

Hennessey, B. A. (1994). The consensual assessment technique: an examination of the relationship between ratings of product and process creativity. *Creativity Research Journal*, *7*(2), 193–208. https://doi.org/10.1080/10400419409534524

Hidalgo, G., Cao, Z., Simon, T., Wei, S-E., Raaj, Y., Joo, H., & Sheikh, Y. (n.d.). *OpenPose 1.7.0*. CMU Perceptual Computing Lab. Retrieved July 14, 2022, from https://cmu-perceptual-computing-lab.github.io/openpose/web/html/doc/index.html

Hutto, D. D., & Myin, E. (2013). *Radicalizing enactivism: Basic minds without content*. MIT Press.

International Federation of the Phonographic Industry. (2022). Global Music Report 2022 – State of the Industry. (n.p.). https://www.ifpi.org/resources/

Kaufman, J. C., & Sternberg, R. J. (2006). *The international handbook of creativity*. Cambridge University Press.

Kello, C. T., Beltz, B. C., Holden, J. G., & Van Orden, G. C. (2007). The emergent coordination of cognitive function. *Journal of Experimental Psychology. General*, *136*(4), 551–568. https://doi.org/10.1037/0096-3445.136.4.551

Kelso, J. A. S. (1995). Dynamic patterns: The self-organization of brain and behavior. The MIT Press.

Kohn, N. W., & Smith, S. M. (2011). Collaborative fixation: effects of others' ideas on brainstorming. *Applied Cognitive Psychology*, *25*(3), 359–371. https://doi.org/10.1002/acp.1699

Kunnen, S. E. & Van Geert, P. (2012). General characteristics of a dynamic systems approach. In S.E. Kunnen (Ed.). *A dynamic systems approach of adolescent development* (pp. 15-35). Taylor and Francis.

Kupers, E., Van Dijk, M., & Lehmann-Wermser, A. (2018). Creativity in the here and now: a generic, micro-developmental measure of creativity. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.02095

Killin, A. (2018). The origins of music: evidence, theory, and prospects. *Music & Science*, *1*. https://doi.org/10.1177/2059204317751971

Larey, T. S., & Paulus, P. B. (1999). Group preference and convergent tendencies in small groups: A content analysis of group brainstorming performance. *Creativity Research Journal*, *12*(3), 175–184. https://doi.org/10.1207/s15326934crj1203_2

Leman, M. (2016). *The expressive moment: how interaction (with music) shapes human empowerment*. The MIT Press.

Lesaffre, M., Maes, P.J., & Leman, M. (2017). *The Routledge companion to embodied music interaction*. Routledge.

Lubart, T. (2017). The 7 c's of creativity. *The Journal of Creative Behavior*, *51*(4), 293–296. https://doi.org/10.1002/jocb.190

Malinin, L. H. (2019). How radical is embodied creativity? Implications of 4E approaches for creativity research and teaching. *Frontiers in Psychology*, *10*, 2372–2372. https://doi.org/10.3389/fpsyg.2019.02372

Maturana, H. R., & Varela, F. J. (1980). *Autopoiesis and cognition: the realization of the living* (V. 42). D. Reidel Pub.

Maturana, H. R., & Varela, F. J. (1992). *The tree of knowledge: the biological roots of human understanding* (Rev.). Shambhala.

McPherson, G., Davidson, J. W., & Faulkner, R. R. (2012). *Music in our lives: rethinking musical ability, development, and identity*. Oxford University Press.

McPherson, G., & Welch, G. (Eds.). (2012). *The oxford handbook of music education* (Vol.2). Oxford University Press

Menary, R. A. (2010). Introduction to the special issue on 4E cognition. Phenomenology and the Cognitive Sciences, 9, 459–463. https://doi.org/10.1007/s11097-010-9187-6

Menin, D., & Schiavio, A. (2012). Rethinking musical affordances. *Avant: Journal of Philosophical-Interdisciplinary Vanguard*, *3*(2/2012), 202–215. https://doaj.org/article/f6cd9f40c2244585ad8f54bc1a90990d

Moreno-Núñez, A., & Alessandroni, N. (2021). What's an early triadic interaction made of? A methodological proposal to study the musical dynamics of interaction. *Infant*

Behavior & Development, *63*(101572), 101572. https://doi.org/10.1016/j.infbeh.2021.101572

Newen, A., Bruin, L. de, & Gallagher, S. (Eds.). (2018). *The oxford handbook of 4E cognition* (Ser. Oxford Handbooks). Oxford University Press.

Nijs, L. (2019). Moving together while playing music: promoting involvement through student-centred collaborative practices. In S. Gies & J.H. Sætre, (Eds). *Becoming musicians. student involvement and teacher collaboration in higher music education* (pp.233-254). Norges Musikkhøgskole.

Nijs, L. (n.d.a). *About KiMuPe*. KiMuPe. Retrieved May 11, 2022, from http://kimupe-approach.weebly.com

Nijs, L. (n.d.b). KiMuPe Exercises. [Manuscript in preperation].

Pauhus, P. B., Dzindolet, M. T., Poletes, G., & Camacho, L. M. (1993). Perception of performance in group brainstorming: the illusion of group productivity. *Personality and Social Psychology Bulletin*, *19*(1), 78–89. https://doi.org/10.1177/0146167293191009

Phan, K. (2022). Kine-Musical Performance – How can the KiMuPe framework be applied to guitar players? [Unpublished manuscript]. Faculty of Behavioural and Social Sciences, University of Groningen.

Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, *39*(2), 83–96. https://doi.org/10.1207/s15326985ep3902_1

Rosenberg, M., Gordon, G., Noy, L., & Tylen, K. (2022). Social interaction dynamics modulates collective creativity. *Proceedings of the Annual Meeting of the Cognitive Science Society*, *44*(44). https://escholarship.org/uc/item/9p3276dt

Sawyer, R. K. (1999). The emergence of creativity. Philosophical Psychology, 12, 447–469.

Sawyer, R. K. (2003). Group creativity: Music, theater, collaboration. Mahwah, NJ: Erlbaum.

Schiavio, A., Van der Schyff. D., Gande, A., & Kruse-Weber, S. (2019). Negotiating individuality and collectivity in community music. A qualitative case study. *Psychology of Music*, *47*(5), 706–721. https://doi.org/10.1177/0305735618775806

Schmidt, R. C., Nie, L., Franco, A., & Richardson, M. J. (2014). Bodily synchronization underlying joke telling. *Frontiers in Human Neuroscience*, *8*, 633–633. https://doi.org/10.3389/fnhum.2014.00633

Schöner, G., & Kelso, J. A. S. (1988). A synergetic theory of environmentally-specified and learned patterns of movement coordination: II. component oscillator dynamics. *Biological Cybernetics*, *58*(2), 81–89. https://doi.org/10.1007/BF00364154

Sievers, B., Polansky, L., Casey, M., & Wheatley, T. (2013). Music and movement share a dynamic structure that supports universal expressions of emotion. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(1), 70–75. https://doi.org/10.1073/pnas.1209023110

Small, C. (1998). *Musicking: the meanings of performing and listening* (Ser. Music/culture). University Press of New England

Smith, L. B., & Thelen, E. (2003). Development as a dynamic system. Trends in Cognitive Sciences, 7(8), 343. https://doi.org/10.1016/S1364-6613(03)00156-6

Sternberg, R. J. (1988). *The nature of creativity: contemporary psychological perspectives*. Cambridge University Press.

Storey, B., & Butler, J. (2013). Complexity thinking in PE: game-centred approaches, games as complex adaptive systems, and ecological values. Physical Education and Sport Pedagogy, 18(2), 133–149. https://doi.org/10.1080/17408989.2011.649721

Sutton, J. (2010). "Exograms and Interdisciplinarity: History, the Extended Mind, and the Civilizing Process," in *The Extended Mind*, ed. R. Menary, (Cambridge, MA: MIT Press), 189–225.

Taylor, D. W., Berry, P. C., & Block, C. H. (1958). Does group participation when using brainstorming facilitate or inhibit creative thinking? *Administrative Science Quarterly*, *3*(1), 23–23. https://doi.org/10.2307/2390603

Thompson, E., & Stapleton, M. (2009). Making sense of sense-making: reflections on enactive and extended mind theories. *Topoi: An International Review of Philosophy*, *28*(1), 23–30. https://doi.org/10.1007/s11245-008-9043-2y

Van der Schyff, D., Schiavio, A., Walton, A., Velardo, V., & Chemero, A. (2018). Musical creativity and the embodied mind: exploring the possibilities of 4e cognition and dynamical systems theory. *Music & Science*, *1*. https://doi.org/10.1177/2059204318792319

Van Dijk, M. (2014, December 17). *The rocky road of human development*. Mindwise. Retrieved June 22, 2022, from https://mindwise-groningen.nl/the-rocky-road-of-human-development-2/

Van Geert, P. (1998). A dynamic systems model of basic developmental mechanisms: Piaget, Vygotsky, and beyond. Psychological Review, 105(4), 634□677. https://doi.org/10.1037//0033-295X.105.4.634-677

Van Geert, P., & Van Dijk, M. (2002). Focus on variability: new tools to study intra-individual variability in developmental data. *Infant Behavior & Development*, *25*(4), 340–374. https://doi.org/10.1016/s0163-6383(02)00140-6

Van Orden, G. C., Holden, J. G., & Turvey, M. T. (2003). Self-organization of cognitive performance. Journal of Experimental Psychology: General, 132(3), 331□350. https://doi.org/10.1037/0096-3445.132.3.331

Varela, F., Maturana, H., & Uribe, R. (1974). Autopoiesis: the organization of living systems, its characterization, and a model. *Biosystems*, *5*(4), 187–196. https://doi.org/10.1016/0303-2647(74)90031-8

Varela, F. J., Thompson, E., & Rosch, E. (2016). The embodied mind: cognitive science and human experience (Revised). MIT Press.

Wahn, B., Kingstone, A., & König, P. (2017). Two trackers are better than one: information about the co-actor's actions and performance scores contribute to the collective benefit in a joint visuospatial task. *Frontiers in Psychology*, *8*, 669–669. https://doi.org/10.3389/fpsyg.2017.00669

Walton, A. E., Richardson, M. J., Langland-Hassan, P., & Chemero, A. (2015). Improvisation and the self-organization of multiple musical bodies. *Frontiers in Psychology*, *6*, 313–313. https://doi.org/10.3389/fpsyg.2015.00313

Appendix

Appendix A: Subjective 4E Experience Questionnaire

Embodied Experience: The following statements relate to **how your body responded to the music while improvising with the others**.
Please indicate on a scale ranging from 1 (strongly disagree) to 7 (strongly agree) how much these statements apply to you.

	Strongly disagree (22)	Disagree (23)	Somewhat disagree (24)	Neither agree nor disagree (25)	Somewhat agree (26)	Agree (27)	Strongly agree (28)
I felt the impulse to move differently with my instrument after the exercises. (1)	○	○	○	○	○	○	○
The body movement changed my perception of my instrument. (2)	○	○	○	○	○	○	○
I paid close attention to how my body resonated with the instrument when we improvised. (3)	○	○	○	○	○	○	○

Embedded Experience: The following statements relate to **how you as a musician related to your physical and social environment**.
Please indicate on a scale ranging from 1 (strongly disagree) to 7 (strongly agree) how much these statements apply to you.

	Strongly disagree (16)	Disagree (17)	Somewhat disagree (18)	Neither agree nor disagree (19)	Somewhat agree (20)	Agree (21)	Strongly agree (22)
It was easy for me to integrate into the improvisation session. (1)	○	○	○	○	○	○	○
During the improvisation, I felt inspired when improvising with other the musicians. (2)	○	○	○	○	○	○	○
After the exercises, playing the guitar felt differently compared to how it was before the exercises. (3)	○	○	○	○	○	○	○

Enactive Experience: The following statements relate to **how you collaborated with fellow musicians while improvising**.
Please indicate on a scale ranging from 1 (strongly disagree) to 7 (strongly agree) how much these statements apply to you.

	Strongly disagree (15)	Disagree (16)	Somewhat disagree (17)	Neither agree nor disagree (18)	Somewhat agree (19)	Agree (20)	Strongly agree (21)
When improvising with the other musicians, I came up with new melodic ideas. (1)	○	○	○	○	○	○	○
The ideas that I came up with while improvising depended on the musicians with whom I was playing with. (2)	○	○	○	○	○	○	○
While improvising I communicated with my fellow musicians through my instrument. (3)	○	○	○	○	○	○	○
I was able to let go of my musical identity while improvising to integrate with my fellow musicians. (4)	○	○	○	○	○	○	○
I felt inhibited during the lessons when improvising with other musicians. (5)	○	○	○	○	○	○	○

Extended Experience: The following statements relate to **how you perceived the music while improvising**.
Please indicate on a scale ranging from 1 (strongly disagree) to 7 (strongly agree) how much these statements apply to you.

	Strongly disagree (16)	Disagree (17)	Somewhat disagree (18)	Neither agree nor disagree (19)	Somewhat agree (20)	Agree (21)	Strongly agree (22)
During the lessons, I liked to initiate musical changes while improvising with the others when I sensed a need to mix things up. (1)	○	○	○	○	○	○	○
I felt immersed in my instrument when I improvised with the other musicians. (2)	○	○	○	○	○	○	○
I felt a deep connection to my fellow musicians when we improvised together. (3)	○	○	○	○	○	○	○

Appendix B: KiMuPe Protocols

KiMuPe – Lesson #1 - March 9, 2022

1. **Welcoming the participants**
   a) Introduction text (written by Merle)
   b) Questions (PowerPoint)
   c) Intro-Questionnaire -> Qualtrics QR-Code (PowerPoint)
2. **Exercise 1.1 – Walking and shaking hands**
   i) Focusing on oneself
   ii) Polite and formal
   iii) Expressive
3. **Exercise 1.2 – Saying hello through music**
   ➔ Playing notes on the guitar, up to participants imagination in relation with the constraints:
   ➔ Drum break as background song (YouTube)
   i) Shape-flow (focusing on oneself, uninterested in others)
   ii) Directional (polite, formal, direct)
   iii) Shaping (expressive, engaged)
4. **Introducing Horizon by Daft Punk**
   a) Moving with the guitar while listening
   b) Chords: Am, D, Em, C, (G)
   c) Feeling the music
5. **Exercise 2 – Plank exercise with the song**
   ➔ Starting with a stiff posture like a plank, the participants are instructed to apply 'hinges' to their body.
   i) Neck
   ii) Hips
   iii) Knees
   iv) Feet/Ankles
6. **Exercise 3 – Stepping to the music**
   ➔ Playing a different song, instructing participants to move and jam with the song while moving to instructor's commands:
   i) Mechanical (robotic, static movement)
   ii) Expressive
   iii) Freeze (holding onto current body posture)

Song: Dire Straits – Six Blade Knife

7. **Improvisation**
   a) Horizon by Daft Punk (YouTube)
   b) Groove Backing Track in C Minor (YouTube)
8. **Wrapping up**
   - Introducing homework exercises -> practicing today's movement exercises at home with own arrangement
   - Tracks for next lesson?
   - Feedback Questionnaires (QR-Code PowerPoint)

Materials and Links

Introduction text:

Welcome to today's session! We are very happy that you have agreed to participate in a music lesson that probably still seems abstract to you. We don't want to tell you too much before we start. But what is important to know is that we have chosen you because you have one thing in common: the love of music and the guitar. We are very excited about our experience today and everything we will learn here.

What you will learn today might seem strange, new and unfamiliar to you at first. And that's perfectly fine! It is very important to us that you all feel comfortable - that no one is judged, laughed at or questioned here. It doesn't matter how well you can play the guitar, that's not the point. We are trying something new here and want to create the space to develop and perhaps see the relationship to the instrument from new perspectives. We will move a lot, try new things and support each other. If you don't feel comfortable with something, please speak up at any time! All opinions, ideas and suggestions are very welcome and even important for the process.

- Daft Punk - Horizon (Japan bonus track)
  https://www.youtube.com/watch?v=JF_QVNfyRY8
- Easy Groove Backing Track in C Minor
  https://www.youtube.com/watch?v=THVxF3EjgDI&ab_channel=SebastienZunino
- Vintage Drum Breaks
  https://www.youtube.com/watch?v=YvwNbEK6zMk&ab_channel=PRIMELOOPS

KiMuPe – Lesson #2 - March 16, 2022

1. **„Guitar-Chat" with participants**
   i) Experiences with the guitar (skills)
   ii) Motivation playing the guitar
   iii) Best moments with the guitar
   iv) Why the guitar? What is your dream to achieve with your music?

2. **Exercise 1 – Saying hello through music**

   ➔ Slow drum track beat in background 65bpm (YouTube). Playing notes on the guitar, up to participants imagination in relation with the constraints:

   i) Shape-flow (focusing on oneself, uninterested in others)

   ii) Directional (polite, formal, direct)

   iii) Shaping (expressive, engaged)

   iv) Creative cues

3. **Exercise 2 – Stepping to the Music**

   ➔ Drum loop in the background 106bpm (YouTube), instructing participants to move and jam with the guitar while moving to instructor's commands:

   i) Mechanical (robotic, static movement)

   ii) Expressive

   iii) Freeze (holding onto current body posture)

   iv) Creative cues: Rockstar, soul, funk, jazz, etc.

4. BREAK

5. **Exercise 3 – Side to side**

   ➔ Participants go 1 by 1, stepping side to side to different rhythms with the guitar

   i) Playing own arrangement (freestyle) on the guitar

   ii) Each participant acts out their performance

6. **Exercise 4 – Stick & Rope**

   ➔ Participants divided into duos, one partner holds a stick or rope while the other partner with the guitar tries to imitate the movement/position of the object.

7. **Improvisation**

   a) Horizon by Daft Punk (YouTube)

   b) Groove Backing Track in C Minor (YouTube)

8. **Wrapping up**

   - General discussion
   - Feedback Questionnaires (QR-Code PowerPoint)

Links

- Daft Punk - Horizon (Japan bonus track)
  https://www.youtube.com/watch?v=JF_QVNfyRY8
- DRUM LOOP / The Isley Brothers - Footsteps In The Dark / 106 bpm - ORIGINAL TEMPO
  https://youtu.be/tF5Ht6hyZ_o

- Easy Groove Backing Track in C Minor
  https://www.youtube.com/watch?v=THVxF3EjgDI&ab_channel=SebastienZunino
- Slow Drum Beat – 65bpm
  https://www.youtube.com/watch?v=0HuIRNWgkAg&ab_channel=BackingTracksChannel

KiMuPe – Lesson #3 - March 23, 2022

1. **Homework review**
   a) How was it in general?
   b) What did you discover?
   c) How can it be useful for you?
2. **Exercise 1 – Air guitar**

Song: Led Zeppelin – Dazed and Confused

3. **Exercise 2 – Stepping to the Music**
   ➔ 1. Drum loop in the background 100bpm (YouTube), instructing participants to move and jam with the guitar while moving freely
   ➔ 2. Song: Los Ángeles Azules – Nunca Es Sufucuente ft. Natalia Lafourcade
4. **BREAK**
5. **Exercise 3 – Side to side / Front to Back**
   ➔ Participants go 1 by 1, stepping side to side and front to back to different rhythms with the guitar
      i) Playing own arrangement (freestyle) on the guitar
      ii) Each participant acts out their performance
6. **Improvisation**
   a) Horizon by Daft Punk (YouTube)
   b) Groove Backing Track in C Minor (YouTube)
7. **Wrapping up**
   - General discussion
   - Feedback Questionnaires (QR-Code PowerPoint)

Links

- 100 BPM - Simple Straight Beat – Drum Track
  https://www.youtube.com/watch?v=zZbM9n9j3_g&ab_channel=LumBeat
- Daft Punk - Horizon (Japan bonus track)
  https://www.youtube.com/watch?v=JF_QVNfyRY8
- Easy Groove Backing Track in C Minor
  https://www.youtube.com/watch?v=THVxF3EjgDI&ab_channel=SebastienZunino

KiMuPe – Lesson #4 - March 30, 2022

1. **Exercise 1 – Air guitar**

Song 1: Santana – Europa (Earth's Cry Heaven's Smile)

Song 2: Two Feet – Felt Like Playing Guitar And Not Singing

2. **Exercise 2 – Stepping to the Music**
   - ➔ Song 1: Drum loop in the background 100bpm (YouTube),
     Song 2: Los Ángeles Azules – Nunca Es Sufucuente ft. Natalia Lafourcade
   - ➔ instructing participants to move and jam with the guitar while moving to instructor's commands:
     i) Mechanical (robotic, static movement)
     ii) Expressive
     iii) Freeze (holding onto current body posture)
     iv) Creative cues: Rockstar, soul, funk, jazz, etc.
3. <u>BREAK – Free playing and singing</u>
4. **Exercise 3 – Stick & Rope**
   - ➔ One of the instructors holds a stick or rope while participants with their guitar try to imitate the movement/position of the object.
5. **Improvisation**
   - ➔ Emphasizing all movement exercises from the past weeks
   a) Horizon by Daft Punk (YouTube)
      - Fading out the music
   b) Groove Backing Track in C Minor (YouTube)
      - Fading out the music
6. **Wrapping up**
   - General discussion
   - Feedback Questionnaires (QR-Code PowerPoint)

Links

- 100 BPM - Simple Straight Beat – Drum Track
  https://www.youtube.com/watch?v=zZbM9n9j3_g&ab_channel=LumBeat
- Daft Punk - Horizon (Japan bonus track)
  https://www.youtube.com/watch?v=JF_QVNfyRY8
- Easy Groove Backing Track in C Minor
  https://www.youtube.com/watch?v=THVxF3EjgDI&ab_channel=SebastienZunino