Effects of Music and Meditative Movement on Affect and Flow: A Feasibility Study

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ABSTRACT

This study aimed to explore the feasibility and the potential effects of adding music to meditative movement on affect and flow. Fifteen participants were recruited and they were randomly assigned to one of the three groups: (a) meditative movement without music (NM); (b) recorded music and meditative movement (RM); and (c) live music and meditative movement (LM). Participants from each group engaged individually in a 45-minute online session, practicing three qigong exercise sets. To determine the feasibility, acceptability, and practicality were investigated through the analysis of anecdotal notes, open-ended questionnaires, and video recordings. Potential effects of music and meditative movement were examined by comparing scores from the Positive and Negative Affect Schedule (PANAS) and Short Flow State Scale (SFSS). Statistical tests were performed to determine pre- and post-session differences, between group differences in affect and flow, as well as the effect sizes. Results indicated that the addition of music to qigong is feasible and has a different impact on affect and flow than meditative movement alone. Adding recorded music to meditative movement led to the largest change in affect and was positively valenced. The addition of live music to qigong exercises contributed to the largest increase in flow. The feasibility and preliminary results support the scientific need for further fully-powered investigations.

KEYWORDS

purposeful use of music, neurologic music therapy, recorded music, affect, Positive Negative Affect Schedule (PANAS), Short Flow State Scale (SFSS)

INTRODUCTION

The mind-body relationship has been a controversial topic for centuries. During Greek and Roman antiquity, the harmonious relationship between the body, mind, and spirit was advocated (Gohde, 2016). In fact, how they could be related and how they could affect each other were further explored by the French philosopher René Descartes in the 17th century. He proposed that the mind and body are two separate entities as they are fundamentally different and could not possibly interact with each other (Cottingham, 2013). However, in recent decades, researchers from various fields hold a different view from Descartes. They are coming together to develop a flourishing body of empirical evidence implicating the interconnectedness of the human mind and body. In particular, Varela et al. (2017) proposed the concept of embodied cognition, where the body and the mind work together to create human experience. Other studies also indicated that body movement is linked to the mind, such as mental attitudes, social stereotypes, emotional experience, feelings of power, personality and leadership styles, and language comprehension (Acolin, 2016).

Meditative Movement, Affect, and Flow

In light of the interrelationship between mind and body, the meditative movement has become increasingly popular in healthcare practices (Wu et al., 2015; Wu et al., 2018) and the body of research that theorizes and examines its effects on well-being is growing (Larkey et al., 2009). Considering it as a new category of exercise, Larkey et al. (2009) first defined it by (a) a clear state of mind, (b) some form of body movements or positioning, (c) a focus on breathing, and (d) the goal to achieve a deep state of relaxation. Unlike traditional exercise forms that focus on external targets and performance goals, meditative movement focuses on bodily sensations and breathing. Yoga, Tai Chi, and Qigong are some examples of meditative movement.

Qigong, which is also known as Chi Kung or Chi Gong, has a long history as a health and wellness exercise in China. On one hand, Qi indicates the life-energy or energetic essence that flows in channels in the body (Guo et al., 2018; Sawynok & Lynch, 2014). On the other hand, Gong refers to the practice or training of qi (Guo et al., 2018). Qigong is self-directed and is composed of concentration, relaxation, meditation, rhythmic breathing regulation, body posture, and gentle body movement (Guo et al., 2018; Pölönen et al., 2019). The aims are to increase vitality, balance circulation, and to harmonize body-mind relationship (Pölönen et al., 2019), where the adjustment of body, breath, and mind transcend into oneness (Klein et al., 2017).

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There are several benefits of practicing meditative movement, such as reducing blood pressure, stress, anxiety, and depression, increasing functional balance, improving immune function, and improving health-related quality-of-life (Kelley & Kelly, 2015; Larkey et al., 2009; Zeng et al., 2014). However, there are only a few empirical studies focusing on the effects of Qigong on affect and flow experience, which could be an important piece of the puzzle. These studies proposed that Qigong produces positive effects on emotion regulation and positive affect, manages distress, and induces flow-like experience (Pölönen et al., 2019; Zhang et al., 2016).

Affect is part of the dynamic system where circular interactions occur between the environment and first-person experience (Schiavio et al., 2017; Varela et al., 2017) In other words, affect is connected to the embodied models of mind (Schiavio et al., 2017), thus, the meditative movement. Affect is sometimes used interchangeably with words like emotion and mood. Although there is a long history of debate about the distinction between them, it is still important to draw some lines of differentiation in order to make a crystalized decision on which construct is investigated.

Scherer (1984) first proposed that affect is a general concept, which inspired researchers to consider affect as the superordinate category for valanced states among the three concepts (affect, mood, and emotion, Batson et al., 1992; Fredrickson, 2001; Gross, 1998; Pölönen et al., 2019). In particular, they pointed out that affect refers to the elementary consciously accessible feelings, such as pleasure, displeasure, tension, calmness, energy, and tiredness (Ekkekakis, 2013; Fredrickson, 2001). It is commonly held that there are two dimensions of affect, positive and negative valence. Positive affect occurs when there is a change from a more valued state to a less valued state, while negative affect occurs when there is a change from a less valued state to a more valued state (Batson et al., 1992). Compared to affect, both emotion and mood have multiple components and are not always constant. The duration of emotion is shorter than that of mood and the intensity of emotion is usually higher than that of mood (Nowlis & Nowlis, 1956).

Considering the exploratory nature of this study, the most desirable outcome would be for the measure to register any changes caused by the experimental manipulation, whether that may be a change in emotion, a change in mood, or free-floating affect. Therefore, affect seems to be the most appropriate construct to be measured.

Flow is defined as an optimal psychological state, where everything comes together as a whole for the performer (Jackson et al., 2010). Flow is intrinsically rewarding and commonly occurs when one is thoroughly involved in the activities at hand, such as meditative movement (Pölönen et al., 2019). Csikszentmihalyi and LeFevre (1989) pointed out that positive affect, creativity, and satisfaction are also the effects of flow experience. They developed the nine-dimensional conceptualization of flow, including challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, total concentration on the task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience. Csikszentmihalyi (1990) stated that only when individuals move beyond their average levels of challenge and skill, they invest psychic energy into a task, marking the beginning of flow experience.

Meditative Movement, Affect, Flow, and Music

Musicality is considered to be part of the dynamic interplay between humans and the environment, and music cognition is essentially affectively embodied (Schiavio et al., 2017). As a highly structured auditory language, music activates the brain areas accounting for perception, cognition, and motor control (Koshimori & Thaut, 2019). The body of research on music neuroscience has been growing and emerging evidence has suggested that interacting with music, whether in passive or active form, profoundly alters the brain by modulating emotion, multisensory perception, and cognition, as well as the motor networks (Cheever et al., 2019). Thus, different musical elements could be manipulated to match various aspects of meditative movement to potentially enhance its benefits. Here music refers to the purposeful use of musical elements, instead of using it as an accompaniment or background to movement. This concept is based on a neurologic music therapy technique called patterned sensory enhancement (PSE). It views music as a facilitator to movement by manipulating various musical elements to create spatial, temporal, and force cues to movements (Thaut, 2014), for instance, using legato notes to present fluid movements, using staccato notes to create jerky movements, using a crescendo (from loud to soft) to convey the increase in muscle force, and using pitch to convey the directions of movement.

To achieve better health-related outcomes, more research has investigated the relationship between music and meditative movement by pairing some of their elements together. Music and movement are suggested to share a common structure within and across cultures (Sievers et al., 2012). Growing evidence indicates multimodal stimuli enhance motor perception, motor control, and motor learning, which is essential in meditative movement (Frassinetti et al., 2002; Sigrist et al., 2013; Soto-Faraco et al., 2003). In particular, when compared to visual information only, additional auditory information enhanced participants' perception accuracy of movement and motor learning (Effenberg, 2005; Effenberg et al., 2016). In addition, embodied approach in music cognition also argues that music listening activates motor-related brain regions, including the basal ganglia, supplementary motor area, premotor cortex, and cerebellum (Stupacher, 2019).

Mindfulness, as a part of Qigong, is the practice of being fully aware of the present moment and one's form of thoughts (Baer, 2003). The neurological bases of mindfulness are emerging in research (Austin, 1999; Mahone et al., 2018). Shamanic trance, a related concept to mindfulness, is suggested to be involved in the activation of brain networks associated with cognition and internal thoughts but the suppression of sensory processing (Hove et al., 2016). However, music, especially listeners' preferred music, could potentially be used as a guide for mindfulness practice because it has a significant impact on brain connectivity (Graham, 2010; Wilkins et al., 2014). Music activates the brain, especially the areas involving internally focused thought, empathy, and self-awareness (Wilkins et al., 2014). The effects of music on meditation were also elaborated by Leisuk (2016)'s study, in which the mindfulness-based music therapy (MBMT) improved mood for the majority of participants.

As music is often viewed as the language of emotions, the relationship and the mechanisms between music and emotions have been receiving more attention since the 2000s (Juslin & Sloboda, 2010). For instance, Hou et al. (2017) suggested the possibility of using music for emotion dysregulation. In fact, music, when used as an intervention strategy, has an impact on emotion regulation because it stimulates neural activities in related regions of the brain, such as cortical and subcortical systems and across cortical-subcortical networks (Moore, 2013). When engaging in aesthetic experiences, like listening to music, positive feelings and sensations of pleasure could be induced as the reward system in the brain is activated to release neurotransmitters such as dopamine, serotonin, and oxytocin (Magsamen, 2019; Moore, 2013).

Aside from altering mood state, flow is also often considered as a potential automatic experience during music listening, composing, and performing (Magsamen, 2019; Wilhelmsen, 2012), which coincides with what Csikszentmihalyi (1990) mentioned:

> Music, which is organized auditory information, helps organize the mind that attends to it, and therefore reduces psychic entropy, or the disorder we experience when random information interferes with goals. Listening to music wards off boredom and anxiety, and when seriously attended to, it can induce flow experiences. (p. 109).

In addition, music drives attention. It provides multidimensional stimulation, brings organization, and provides an additional dimension of emotion and motivation, as it activates the frontal lobes and helps facilitate concentration (Thaut & Gardiner, 2014). The relationship between flow and music could also be explained by groove, which is frequently referred to as the drive to move one's body to the rhythm (Stupacher, 2019). Through these groove experiences, the excitability of the motor cortex is increased and more accurate sensorimotor synchronization is achieved (Janata et al., 2012; Stupacher et al., 2013). As a result, the experience of groove promotes a highly pleasurable state of being where individuals become present in both the music and body (Danielsen, 2006). This is similar to one of the flow dimensions, loss of self-consciousness, as suggested by Csikszentmihalyi (1975). However, results from previous studies are yet to provide consistent and conclusive evidence for the connection between flow state and music (Stupacher, 2019).

The current study examined the interplay between music, meditative movement, affect, and flow. It aims to serve as a foundation and guide other researchers to further develop a common groundwork of explanation of this interdisciplinary topic. Further research is warranted on this topic to fill the knowledge gap between music perception, body movements, and the embodied mind. In order to fill the gap, the specific objective of this study was to explore the feasibility and the potential effects of adding music to meditative movement on affect and flow-like experience.

METHOD

This study utilized an exploratory design as the study of music perception, the mind-body relationship, and well-being is a newly developed area. The goal of the study was to gain insights and familiarity on the subject and guide later investigations. As a result, this study was conducted to determine feasibility and provide initial data before conducting a fully powered study.

It is more common to collect only qualitative data in an exploratory design because gaining more in-depth understanding is still the primary concern (Moura, 2018). However, since one of the research aims is to obtain preliminary data on the effects of predictor variables (i.e. music and meditative movement) on the outcome variables (i.e. affect and flow), quantitative data from questionnaires is also needed. Thus, a mixed method was adopted in the study. Both quantitative data and qualitative data were collected to better understand the relationships between music, meditative movement, affect, and flow. A between-group comparison design was employed to observe any difference between music conditions and qigong exercises. Within-group analyses were conducted to examine the effectiveness of each predictor variable by comparing pre-to-post-test differences.

In order to increase the internal validity, several extraneous variables were considered, including participant variables, researcher variables, and situational variables. For instance, recruiting participants with a similar educational background, having the same experimenter, giving the same types of qigong exercise sets, conducting sessions on an individual basis, following the same procedure, and using the same measurement tools. However, it is noted that it is impossible to eliminate all confounding variables, which is further elaborated in the Discussion section.

Participants

The inclusion criteria were that participants needed to be 18 years old or older and enrolled at the university with which the authors were affiliated. Exclusion criteria included any hearing impairment that precluded participation (listening to music) and any physical limitations that prevented them from performing light physical exercise (qigong).

This study was approved by the Human Subject Institutional Review Board (HSIRB) at Western Michigan University. Recruitment emails were sent to faculty in relevant departments, including the School of Music, Occupational Therapy, Physical Therapy, Holistic Health, and Psychology. Professors from these departments were provided with the recruitment script and asked to disseminate invitations to students in their courses/programs. Potential participants contacted the investigator to express their interest through email and the investigator emailed them back with more information and arranged for the consent document review. This process continued on a first-come first-served basis until enough participants were enrolled in the study.

During the consent document review, the investigator explained the research purpose and design to participants through a secure and Health Insurance Portability and Accountability Act (HIPAA)-compliant platform. Once they agreed to and emailed back the consent documents to the investigator, they were randomly assigned to one of the three groups: (a) meditative movement without music (NM); (b) recorded music and meditative movement (RM); and (c) live music and meditative movement (LM).

Demographic data was collected to examine potential relationships between these attributes and the outcome variables. Participants (N = 15) were aged between 18 years to 25 years, with 14 females and 1 male. They described themselves as Asian (33.33%), Caucasian (60%),

and as belonging to two or more ethnic groups (6.67%). For academic class standing, they reported they were sophomores (66.67%), juniors (6.67%), seniors (20%), and graduates/professionals (6.67%). The academic major reported included criminal justice (13.33%), occupational therapy (13.33%), psychology (40%), speech-language pathology (6.67%), interdisciplinary health services (13.33%), and music therapy (13.33%). Participation in this study was on a voluntary basis. Compensation in the form of extra credit for academic coursework was available for some participants in several specific college courses.

Research Design and Procedure

This study included three between-group comparisons (i.e., no music, recorded music and live music) and two within-subject outcome variables (i.e., affect and flow). Affect was measured using the Positive And Negative Affect Schedule (PANAS) and was administered pre- and post-session. Flow was measured using the Short Flow State Scale (SFSS) and was administered following each meditative movement intervention. Due to the pandemic, the data collection sessions were conducted remotely, from September 28th, 2020 to October 6th, 2020. Data collection occurred on Cisco WebEx and on an individual basis. That is, participants engaged only with the investigator and not in a group setting. Participants and the investigator only met once online for approximately 45 minutes and the sessions were recorded with the participants' consent. The investigator was in her home and each participant participated remotely from their homes or other location of their choosing amenable to study procedures. To ensure privacy and confidentiality of the participants, the investigator was in a secured room alone.

Prior to the start of data collection, the investigator reviewed the consent documents with the participants and they were given the opportunity to ask any questions. Once they consented to participate in the study, they signed the consent forms and emailed them back to the investigator. Consent was obtained from each participant.

To reduce the risk of having confounding variables and to increase internal validity, random assignment was administered. ID numbers were randomly assigned to participants and then were randomly sorted into three groups using an online program RANDOM.org. Therefore, each participant had an equal probability of being assigned to each level of independent variables, that is, NM ($n = 5$), RM ($n = 5$), and LM ($n = 5$).

With the aim of providing the same order of exercises and duration of session, participants followed the same steps during each data collection period:

1. Received an email regarding an invitation link to the questionnaire
2. Filled out the first PANAS
3. Practiced the first qigong exercise: Body opening and relaxing exercises
4. Filled out the first SFSS
5. Practiced the second qigong exercise: A crane spreads its wings
6. Filled out the second SFSS
7. Practiced the third qigong exercise: Joining heaven and earth
8. Filled out the third SFSS, second PANAS, open-ended questionnaire, and demographic questionnaire

Participants were prompted to watch three qigong exercise video sets and mirror the movements as soon as comfortable. According to Pölönen et al. (2019), the exercise sets were designed following the typical training methods in qigong, which was moving from extended, external, and large-scale movements to subtler, inner, and small-scale movements. The first exercise was "opening and relaxing the body," second was "a crane spreads its wings," and the third was "joining heaven and earth" (Pölönen et al., 2019, p. 4-5). Each of the exercise sets included a variety of movements, a meditative focus, and breathing.

The method of delivery and/or the audio of the qigong exercise sets varied across conditions with the intention to provide a better quality of intervention. Considering the issue of internet connection and potential audio delay problems, the more desirable way of delivery was to have participants open the video on their own electronic devices. For NM, the qigong exercise sets were the exact video sets from Pölönen et al. (2019). Participants received YouTube links to these exercise sets through Cisco WebEx. For RM, the qigong exercise sets were paired with original music composed by the investigator. Participants received the YouTube links to these exercise sets through Cisco WebEx. For LM, the qigong exercise sets used were the same as the ones in NM. However, the investigator provided live piano music while sharing the screen of exercise sets on YouTube with the participants on WebEx. The music provided matched the video's movements, as opposed to matching participants' movements, so substantial audio delay problems were prevented.

Materials

MEASUREMENTS FOR FEASIBILITY

There are eight general areas of focus that could be included in feasibility studies: acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited-efficacy test (Bowen et al., 2009). For this project, acceptability and practicality of intervention were chosen to determine feasibility. On one hand, acceptability refers to the perception by intended individuals (Bowen et al., 2009), such as their reaction to the proposed interventions (qigong, music). In this study, consent rate and completion rate were calculated and responses from open-ended questionnaires were also used to examine their perceptions on the study's procedure. Questions included (a) "Did you feel questionnaire-filling was disruptive to the maintenance of a meditative focus?" and (b) "Do you have additional comments/ questions/ concerns you would like to share?" On the other hand, practicality refers to the extent in which the interventions can be carried out using existing resources (Bowen et al., 2009). Session recordings, anecdotal notes from the investigator and open-ended questions were used to examine the practicality.

MEASUREMENTS FOR POTENTIAL EFFECTS

The participants were contacted on a secured and HIPAA-compliant platform, Cisco Webex, individually for each 1:1 data collection period. There were four measures in the questionnaire, including the PANAS, the SFSS, the open-ended questions, and the demographic questions. At different points in the session, participants were prompted to com-

plete questionnaires on Qualtrics, which were later transferred directly into SPSS v. 27 for data analysis.

Affect. For the selection of a measure of affect, Ekkekakis (2013) recommended to follow three steps: (a) consider the definition of the three constructs (affect, mood, and emotion), (b) consider the structure, dimensionality, and polarity, and (c) consider the validity and reliability of the chosen conceptual model. In line with the aim of the study, affect was selectively targeted as one of the dependent variables because it is the most general construct among the three. Therefore, any changes in affect elicited by the interventions could be registered, whether that may be the change in emotion, mood, or free-floating affect.

On this basis of conceptual framework, the PANAS was administered in this investigation. The scale consists of twenty descriptors, with ten for positive affect and ten for negative affect. Participants were prompted to rate each descriptor on a 5-point Likert scale (1=*Very slightly or not at all*, 2 = *a little*, 3 = *moderately*, 4 = *quite a bit*, 5 = *extremely*) before and after the session. The positive affect score is calculated by summing all scores from positive items. The range of scores is from 10 to 50, with higher scores indicating higher levels of positive affect. The negative affect score is calculated by summing all scores from negative items. The range is from 10-50, with higher scores indicating higher levels of negative affect. The total PANAS score is calculated by subtracting the negative affect score from positive affect score, where the sign of deviation from zero indicates positive valence. The change in affect was calculated by subtracting the pre-session total PANAS score from post-session PANAS score.

The Cronbach's α reliabilities of the PANAS were relatively high in this current study, with 0.82 for total affect. These results coincided with Watson et al. (1988), their Cronbach's α reliabilities were high as well, with 0.88 for positive affect and 0.87 for negative affect. Their preliminary results indicated that the PANAS demonstrated a significant high level of internal consistency and suggested a high test-retest reliability (Watson et al., 1988). Compared to other mood scales, the PANAS demonstrated the clearest convergent/discriminant pattern, with convergent correlations ranging from 0.89 to 0.95, while the discriminant correlations ranged from -0.02 to -0.18 (Watson et al., 1988). Therefore, it was suggested that the PANAS scale is a reliable and valid measure of affect.

Flow. Jackson et al. (2010) developed several scales to measure flow, including the long and short versions of dispositional flow scales (physical and general), the long and short version of flow state scales, and the core dispositional flow scale. Similar to Pölönen et al. (2019), state flow was chosen to be measured as one of the outcome variables because of its focus on the holistic concept of flow as one coherent experience. Therefore, a post-event assessment of flow, such as Long Flow State Scale (FSS-2) and the SFSS, would be more appropriate compared to other dispositional flow scales. Although the FSS-2 provided the most comprehensive assessment of flow and had a higher internal consistency than the SFSS, the SFSS was administered in this study because of practical considerations: the willingness to complete scales and disturbance to flow.

In the SFSS, there is one item for each of the nine flow dimensions, including the challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, total concentration on the task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience (Csikszentmihalyi & LeFevre, 1989). Participants were prompted to rate each item with a 5-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree or disagree*, 4 = *agree*, 5 = *strongly agree*) after each qigong exercise. The score from each item was used to represent each flow dimension and the total flow score was calculated by summing the 9 items together and then dividing them by 9. The range of flow scores was from 1 to 5, with lower scores indicating a lower level of flow-like experience and higher scores indicating a higher level of flow-like experience.

The internal consistency of the SFSS in this study was considered to be high (α = .90), which coincided with Martin et al. (2006, α = .82). Jackson et al. (2010) also reported a high correlation between the FSS-2 and SFSS (α = .89), indicating the short scale captured the essence of its corresponding long scale.

DEMOGRAPHIC QUESTIONNAIRE

Participants were asked to provide demographic information by the end of the session. The questions included: (a) "What is your age?" (b) "What gender do you identify as?" (c) "Please specify your ethnicity." (d) "Major" and (e) "What is your academic class standing?"

INDEPENDENT VARIABLES

Participants were prompted to watch three different qigong exercises and follow the movement as soon as comfortable. The original exercise videos from the study by Pölönen et al. (2019) were downloaded from YouTube (links were available in their published study). The videos were uploaded onto YouTube again for NM and with the addition of music for RM and LM. (https://youtu.be/H-PvqEkExTs, https://youtu.be/pA0nV8wPpSM, https://youtu.be/TXdU6fWGiyM) YouTube links were sent via Cisco WebEx chat for NM and RM.

Creation of Auditory Stimuli. The music compositions used in RM and LM were identical. They were several original pieces composed by the investigator according to the guidelines of PSE. The following principles guided the composition process: (a) Pitch variation guides the position, direction and the range of motion; (b) sound duration, tempo, meter, and rhythmic patterns reflect the velocity and timing of movement; and (c) dynamics and harmony indicate the force needed behind the movement (Thaut, 2014). For instance, auditory cues were composed without using meters because the movements were not rhythmic in nature, ascending scales and higher pitches were used to direct upward movement, such as raising arms, thicker chords were used to cue the muscle contractions necessary for squatting positions, and faster tempo was used when faster movements were indicated. Music was recorded using Pro Tools 2018.4 and then added to the videos using iMovie. Participants in the LM group watched the videos via the shared screen on Cisco WebEx from the investigator's laptop.

Data Analysis

The demographic questionnaire was evaluated by measures of frequency. Group comparison analysis was also performed with each demographic item against the PANAS and SFSS scores to determine their relationships.

MEASUREMENTS FOR FEASIBILITY

Acceptability was examined through calculating the consent rate, completion rate, and analysis of the open-ended responses from questionnaire while practicality was investigated through an analysis of session video recordings, anecdotal notes from the investigator, and open-ended questionnaires on Qualtrics. The consent rate was obtained by dividing the number of participants who were willing to consent to the study by the number of people who expressed initial interest in participation. The completion rate was calculated by dividing the number of participants who finished practicing all exercises and filled out all questionnaires by the number of participants who consented to the study. Content analysis of video recordings, anecdotal notes, and open-ended responses from the questionnaire was also conducted in order to determine the feasibility of the study.

MEASUREMENTS FOR POTENTIAL EFFECTS

The statistical data was collected via Qualtrics and then loaded to SPSS v.27 for analysis. Although it is typically not appropriate to report inferential statistics in a feasibility study, a well-designed and well-executed feasibility study with sufficient power may assist in the priori sample size analysis for a larger study (LaGasse, 2013). Therefore, several statistical tests were used in the study. Since the difference between the adjacent scale values in both the PANAS and the SFSS could not be assumed as equal, the level of measurement was ordinal. Participants were grouped by the assigned condition (NM, RM, and LM).

Multiple statistical analyses were used in the study for between-group and within-group comparisons. The Wilcoxon paired signed-rank test was used to examine the change in affect (PANAS scores) before and after the session for both between-group and within-group comparisons. Friedman's two-way analysis of variance (ANOVA) by ranks was used to test differences in flow (SFSS) among the three exercise sets, as it could be used for data that has violated the assumptions necessary to run the one-way repeated-measures ANOVA. The Kruskal-Wallis H test was then used to examine differences in affect and flow between three groups. A post-hoc analysis (i.e., Dunn's pairwise tests and Wilcoxon signed-rank tests with a Bonferroni correction applied) was conducted to obtain the effect sizes and determine where the difference occurred, if appropriate. Spearman's rank correlation was used to examine any interactions between the PANAS and the SFSS. For all the tests, results with p values less than .05 were considered statistically significant.

RESULTS

Demographic Variables

Group comparison analysis was conducted to determine any correlation between demographic variables (i.e., age, gender, ethnicity, major, and academic class standing) and the dependent variables (affect and flow). No statistically significant effects were found. Therefore, all participants were treated only as group members in their randomly assigned conditions.

Feasibility

ACCEPTABILITY

Acceptability was investigated through calculating the consent rate and completion rate. Twenty-five individuals contacted the investigator initially and expressed interest in participation. Seventeen out of 25 individuals further agreed to consent to the study. Two out of 17 individuals did not participate in the study eventually, as one did not meet the inclusion criteria and one did not show up during the assigned time slot. The remaining fifteen participants consented to participate and completed the study. Thus, the consent rate was 68% and the completion rate was 100%.

Participants were asked if they felt the questionnaire-filling was disruptive to the maintenance of a meditative focus. Among fifteen participants, one reported disruption (6.67%), two reported slight but understandable disruptions (13.33%), and the majority did not report disruptions (80%) during those periods of time. For those who did not feel disrupted, some reported that the questions were easy and not a lot of mental energy was needed, some reported the questions allowed some rests in between, and some reported that the questions gave them time to reflect and notice their feelings changed.

PRACTICALITY

All participants were able to follow all the qigong exercise sets and completed all the evaluation instruments. There were no internet connection and delay problems reported by participants and observed by the investigator. This was also supported by the open-ended responses in the questionnaire, with no participants reporting technical issues during the session. The time for completion was adequate (i.e., approximately 45 minutes/session). However, according to the video recordings of the sessions, the quality of music delivered to participants in live music condition was not ideal. For instance, some music notes were missing, and some notes were not clear when played softly.

Potential Effects

As stated above, inferential information could be used in creating an a priori sample size analysis for further studies, indicating any potential relationships between variables and the trajectory of the data. As such, they are not intended to report population differences. Thus, the results of the statistical analysis and content analysis are presented in the following section.

STATISTICAL ANALYSIS

Correlation Between Affect and Flow. A Spearman's rank-order correlation was run to examine the relationship between participants' total PANAS scores and SFSS scores. There was no statistically significant correlation between the PANAS and SFSS scores, that is, there was no correlation found between affect and flow.

Affect. At the beginning and the end of the session, each participant's affect was measured with the PANAS to observe any effects of meditative movement (see Figures 1 and 2).

Total affect, positive affect, and negative affect changes before and after the session (whether NM, RM, or LM) reached statistical signifi-

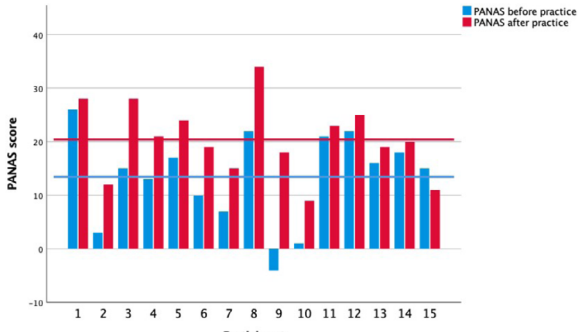

FIGURE 1.

Individual Participants' Pre-Session (Blue) and Post-Session (Red) PANAS Score

Note. Participants 1-5 were in meditative movement without music group (NM), participants 6-10 were in recorded music and meditative movement group (RM), and participants 11-15 were in live music and meditative movement group (LM).

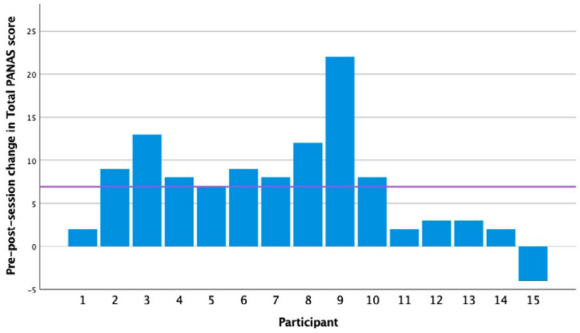

FIGURE 2.

Average Pre-Post Session Change in TOTAL PANAS Score for Each Individual Participant

Note. Participants 1-5 were in meditative movement without music group (NM), participants 6-10 were in recorded music and meditative movement group (RM), and participants 11-15 were in live music and meditative movement group (LM).

cance on the Wilcoxon paired signed-rank test (see Table 1). A post-hoc analysis indicated the effect sizes of the changes were large, $r > 0.5$. The difference between pre- and post-session median PANAS scores is also presented in Table 1.

Between-group comparison. To examine if there was a difference between the effects of meditative movement without music, with recorded music, and with live music, the changes in PANAS scores for each group were computed. For pre- to post-session changes in positive affect, negative affect, and total affect, Kruskal-Wallis's H test was used and significant results were found (see Table 1).

In order to determine where differences occurred, post-hoc Dunn's pairwise tests were performed to compare all pairs of groups (see Table 2). A statistically significant difference was observed in pre- to post-test changes in positive PANAS scores between RM (12.8) and LM (4.60, $p = .01$). There was also a difference in pre- to post-test changes in total PANAS scores between RM (11.50) and LM (3.60, $p = .014$). Pre- to post-test changes in negative PANAS scores between NM (12.10) and LM (4.70) were also statistically significant ($p = .025$). It was also noted that the difference in pre-to post-test positive PANAS scores between NM (6.60) and RM (12.80) reached statistical significance ($p = 0.027$) before the adjustment by the Bonferroni correction for multiple tests.

Within-group comparison. Pre- and post-test comparisons were also made using the Wilcoxon signed-rank test to examine for which group the intervention was effective (see Table 3). This test allows for higher statistical power than between-group tests and produces effect sizes that are more useful for determining clinical significance of the interventions. For RM, positive affect increased statistically significantly between the first and third qigong videos, also indicating improved affect, $z = 2.03$, $p = .04$, $r = .64$. For pre- and post-test comparisons, negative affect decreased for LM between the first and third qigong videos, indicating improved affect, $z = 2.02$, $p = .04$, $r = .64$. No statistically significant pre-to-post changes were observed for the NM group.

Flow. To reflect on their flow-like experience, participants were prompted to fill out the SFSS questionnaire after practicing each qigong exercise set. One item in the SFSS probed the participants to rate the difficulty of the exercise set on a scale of 1-7, with 1 being too low, 4 being just right, and 7 being too high. The majority (93.33%) reported the task difficulty was just right, meaning a good balance between task demand and capability. The SFSS scores of each exercise

TABLE 1.

Pre- to Post-Session Difference in and Median PANAS Scores

	Z	Asymp. Sig. (2-tailed)	*r*	Pre	Post	Change	*H*	*p*	η^2
Negative affect	−3.19	.001*	0.82[a]	15	10	-5*	7.18	.028*	0.51b
Positive affect	−2.09	.037*	0.54[a]	30	31	+1*	9.36	.009*	0.67b
Total affect	−3.07	.002*	0.79[a]	15	20	+5*	8.25	.016*	0.59b

Note. *Z* = Wilcoxon paired signed-rank test *Z* statistic. Difference was calculated by subtracting post-session PANAS scores from pre-session PANAS scores, with negative value indicated a decrease in score and positive indicated an increase in score. *H* = Kruskal-Wallis *H* test statistic, *R* = Standard value *r* effect size, where small = 0.1, medium = 0.3, and large = 0.5a, η^2 = Eta-squared effect size, where small = 0.01, medium = 0.06, and large = 0.14b.

*Statistically significant ($p < 0.05$) difference before and after the session.

TABLE 2.
Pre- to Post Changes in Medium Ranks of Negative, Positive, and Total PANAS Scores Between No Music, Recorded Music, and Live Music Groups

	NM	LM	*p*
Negative affect	12.10	4.70	.025*
	RM	LM	
Positive affect	12.80	4.60	.01*
	RM	LM	
Total affect	11.50	3.60	.014*

Note. NM = meditative movement, RM = recorded music with meditative movement, LM = live music with meditative movement.
*Statistically significant ($p < .05$) difference between music conditions.

TABLE 3.
Pre- to Post Changes in Group PANAS Scores

Groups	Pre- and post comparison	*p*	*r*
NM	Positive Affect	1.00	0.00
	Negative Affect	.07	0.58
RM	Positive Affect	.04*	0.64
	Negative Affect	.07	0.58
LM	Positive Affect	.27	0.35
	Negative Affect	.04*	0.64

Note. r = Standard effect size calculated using $r = \frac{z}{\sqrt{N}}$ with N = number of data points (Field, 2018). *Statistically significant ($p < .05$) differences before and after session.

TABLE 4.
SFSS Scores of Each Qigong Exercise Set from All Samples

	N	Minimum	Median	Maximum	*SD*
Exercise 1	15	2.33	3.89	4.33	0.59
Exercise 2	15	2.89	3.78	4.78	0.59
Exercise 3	15	3.11	4.22	5.00	0.64

Note. The range of possible responses is from 1 to 5 using whole numbers, i.e., 1, 2, 3, 4, 5, with lower scores indicating a lower level of flow-like experience and higher scores indicating a higher level of flow-like experience.

set are presented in Table 4. To examine the effects on flow-state that could be attributed to individual videos regardless of music condition, Friedman's two-way ANOVA by ranks was used to test any difference between exercise sets. Statistically significant results were found, $\chi^2(2) = 11.81$, $p = .003$. The effect size (Kendall's W value) was 0.39, which was considered as a moderate effect (Field, 2018).

In order to determine where the difference occurred, post-hoc analysis with the Wilcoxon signed-rank test was conducted with a Bonferroni correction applied (see Table 5). The Bonferroni correction was applied to reduce the risk of a type I error (rejecting a null hypothesis incorrectly). Our α level was set at .05, so with three groups, that

TABLE 5.
Between-Group Differences in Median Ranks of SFSS Scores Across All Participants

	FS2-FS1	FS3-FS1	*FS3-FS2*
Z	−1.79	−2.36	−1.86
Asymp. Sig. (2-tailed)	.073	.018	.063

Note. Z = Wilcoxon signed ranks test, Asymp. Sig. (2-tailed) = significance level, FS1 = flow score after Video 1, FS2 = flow score after Video 2, FS3 = flow score after Video 3.

is, Video 1, 2, and 3, the Bonferroni calculation was .05/3, setting the new level of significance to .017. There was a statistically nonsignificant difference in flow scores between Videos 2 and 3 ($p = .063$) with a small effect ($r = .23$). Using the Bonferroni adjusted p-value (.017), the difference in flow scores between Videos 1 and 3 were statistically nonsignificant ($p = .018$) with a medium effect ($r = 0.37$).

For the differences in flow scores between music conditions, a Kruskal-Wallis H test was used. However, there were no statistically significant differences in average flow scores across all three videos, flow scores of each video, or the rating of challenge-skill balance between the groups. However, the Wilcoxon signed-rank test showed that between the first and last administration of the SFSS, flow significantly increased during live music, $z = 2.03$, $p = .04$, $r = .64$.

Content Analysis

Participants were asked whether they had additional comments, questions, or concerns they would like to share at the end of the session. Among fifteen answers, six participants (40%) expressed a positive attitude towards the experience. They described the experience to be novel, helping them feel more relaxed, energetic, and focused. In particular, one participant reported finding the melody of music helpful in guiding the movement. Other participants (60%) did not offer any further comments at the end of the session.

DISCUSSION

The aim of the current study is to fill in the knowledge gap regarding the relationship between music, meditative movement, and affect and flow. Within this broad range of research, this study specifically focused on the feasibility and the potential effects of incorporating music into qigong on affect and flow. Drawing from the results presented, the addition of music to qigong is feasible and has a different impact on both affect and flow-like experience than meditative movement alone.

Feasibility

Prior to establishing any larger studies on the topic, feasibility studies are needed to obtain fundamental information, such as the acceptability and practicality of study procedures and interventions, thus, avoiding unanticipated complications as much as possible in the future.

ACCEPTABILITY

The study procedure and interventions were acceptable to the participants, which was supported by the good consent rate (68%), the good completion rate (100%), and open-ended responses. The good consent rate may have been due to the fact that some participants could obtain extra credit for academic coursework in several specific college courses. Another reason may have been that the participants were interested in this newly developed topic, which was implied by the open-ended responses. Having a good consent rate indicates there is a high probability of successful participant recruitment in the future.

The good completion rate meant all participants completed all qigong exercises and all the measurement tools, which is another indicator for the study's acceptability. It could be because the exercise sets were short and consisted of simple movements only. Another explanation could be that the questionnaires included in the study were relatively short and concise, such as using a short version of the flow state scale.

Open-ended responses also reflected that the procedural protocol was reasonable. In particular, the addition of questionnaire-filling periods in the study was accepted by the majority of participants. They reported feeling undisturbed by those periods of time and some even stated that they helped them rest and reflect on the experience. It might be because the questionnaires were short (i.e. only 9 items for the SFSS) and relatable to what the participants were doing during the exercises, so that they did not feel interrupted.

PRACTICALITY

With the available resources and limited time, the delivery of intervention (qigong and music) was considered successful in general, which was demonstrated by the anecdotal notes, the open-ended responses, and the session recordings. All participants were able to watch and follow the qigong exercise sets online and complete all online questionnaires. No technical problems were reported, and the overall completion time was within expectation (i.e., approximately 45 minutes/ session). These indicate that the difficulty levels of the intervention and measurement tools were appropriate and manageable to participants. Achieving a similar duration in each session could be credited to prior tests, the online meeting platform, survey platform, and the whole procedure.

It is worth noting that there is still room for improvements regarding the delivery of live music. Although all participants were able to finish mirroring the movements in the videos, the quality of music presented in the live music condition was not ideal according to the video recordings. Participants were able to listen to the live piano music but some notes were missing or unclear. It could be because only a laptop's built-in microphone was used and it was not adequate for registering all the changes in musical elements.

Potential Effects

Despite the fact that inferential statistics in feasibility studies are not commonly used to draw conclusions, some crucial findings with sufficient power are still presented with the goal to obtain preliminary results on the topic and help determine whether a larger trial is warranted.

AFFECT

Qigong exercises have a positively valenced effect on participants' affect, which supports the findings by Pölönen et al. (2019) and Zhang et al. (2016). The significant changes in pre- and post-session median PANAS scores indicate that these exercises could decrease participants' negative affect, increase positive affect, and increase the total affect. Open-ended responses from the participants reported feeling more relaxed, energetic, and focused after the experience, which may explain the changes in the PANAS scores.

Between-Condition Comparisons. In terms of the difference in effect between conditions, the LM condition seemed to have a lesser effect on affect when compared to the RM condition as well as the NM condition. This might be due to the fact that the mean pre-session PANAS score in the LM condition was higher than in the RM and NM conditions. Therefore, participants in the LM condition had less room for positive changes in affect scores. Also, the quality of the live piano music presented was not ideal. The statistically significant difference between the LM and RM conditions may support this speculation since the music content was the same and the only difference was the mode of presentation. However, it was noted that the RM condition had a statistically significantly better effect on positive affect than the NM, indicating that recorded music seemed to enhance the effect on affect.

Within-Condition Comparisons. A large effect size was observed for pre- to post-test decrease in negative affect in the LM condition, indicating that the effectiveness of live presentation of music for motion sonification was not only statistically significant, but behaviorally significant. Similarly, a large effect size was observed for the increase in positive affect in the RM condition, indicating both statistical and behavioral significance.

These findings coincided with previous studies where favorable changes in affect were observed for the purposeful use of music (Hou et al., 2017; Lesiuk, 2016; Moore, 2013).

FLOW

Participants experienced flow at different levels after three qigong exercise sets, which supports the results by Pölönen et al. (2019). The higher median flow score indicates a higher level of flow-like experience in participants. However, the reason behind this observation is not definite. The difference may have been due to the cumulative time, learning effect, the different content among exercises, participants' perception, and more. It could also indicate that there was a near-statistically significant change in flow-like experience between Exercise Sets 1 and 3, meaning there seemed to be an increasing trend of flow-like experience throughout the procedure. It also indicates that flow experience seems to be related to time, and it takes at least 15 minutes to begin. Live music also seemed to increase flow-like experiences since there were large effect sizes of statistically significant increases in flow state in the LM condition. This finding coincides with what Csikszentmihalyi (1990), Janata et al. (2012), and Stupacher et al. (2013) previously described. It was believed that music could help organize the mind and induce flow experiences.

Implications

The current study investigated the effects of qigong and treated it as a pathway to comprehending meditative movement. The results support the incorporation of music into meditative movement as feasible and potentially producing a different effect than meditative movement alone, rendering the application of the intervention substantial and meaningful for both practitioners. The preliminary results also suggest that meditative movement has a positive effect on the practitioners' affect and flow-like experiences. This effect could already be observed even if the practitioners were only involved in practice for one 45-minute session.

This information could contribute to the beginning stage of theory development as it guides hypothesis formulation. For instance, music, when used purposefully and paired with meditative movement, will positively shift affect toward positive valence. There are indeed more questions to be answered before reaching a common groundwork of explanation and a better understanding of the relationship surrounding music, meditative movement, and affect and flow.

The findings of the current study demonstrate the acceptability and feasibility of using online resources as a means to enhance affect and flow-like experience. Because of COVID-19, plenty of people stay home more often than ever, leading to isolation, loss of income, bereavement, and fear of triggering or exacerbating mental health conditions (Brunier & Drysdale, 2020). It could be argued that these accessible digital resources are particularly valuable to such groups as students, adults, and older adults with no hearing and physical impairments that prevent them from practicing these exercises. They could potentially improve their affect quickly. For healthcare professionals, such as nurses and music therapists, meditative movement could also be utilized together with music to enhance the positive effects for the patients' benefits.

Limitations and Recommendations for Future Research

Convenience sampling was used and the effects observed in the study may not represent the general population. The equipment used by the participants to engage in the exercises was not standardized and varied from phones to laptops to tablets (and perhaps some used televisions, but that was not specifically determined). Given the difference in video and audio outputs of these various devices, it is possible that it could have impacted the participants' ability to follow the audio and video cues. Also, participants' behaviours may have been affected by a number of factors including knowing the session was being recorded, the investigator observing them, and the pre-test.

The participants' background influences the internal validity of the study. Although only university students were included in the study, their experience in practicing meditative movement was not considered. A full-scale version of this study should include previous experience with meditative movement and specify which exercise(s) participants may have participated in, e.g., qigong, tai chi, or yoga.

There were several limitations in the measures. The standardized scales (PANAS and SFSS) were used to obtain quantitative data while open-ended questions, anecdotal notes, and session recordings were used to obtain qualitative data. However, there were only two open-ended questions and unstructured anecdotal notes, which were insufficient to capture the overall quality of experience among participants. Future studies could include questions such as (a) How would participants describe their affective state? (b) How would participants describe their flow experience during the exercise? (c) How would participants describe the whole experience? Nonetheless, the limited content analysis from these sources were still relevant and valid for answering the research questions regarding the feasibility and potential effects. Pölönen et al. (2019) argued that there is still a need to search for the most appropriate measurement instruments for affect and flow. In particular, a limitation of using a post-test, self-reported questionnaire would be the inability to capture the in-the-moment experience.

In the current study, only one session was conducted and short-term effects were measured. However, previous studies (Csikszentmihalyi, 1975, 1990; Danielsen, 2006; Hou et al., 2017; Kelley & Kelley, 2015; Larkey et al., 2009; Leisuk, 2006; Moore, 2013; Pölönen et al., 2019; Stupacher, 2019; Wilhelmsen, 2012; Zhang et al., 2016) were conducted across multiple sessions and lasted longer for each session. Also, among all the possible effects of meditative movement, the current study only focused on affect and flow. Other outcome measures should be considered, including stress, relaxation, attention, flexibility, and more.

Since the current study was conducted via an online platform, potential internet connection and audio delay problems were anticipated. As a result, the live music played by the investigator may not have been as time-locked as would be expected in in-person sessions.

The feasibility and scientific outcomes of this study warrant a larger-scale trial to obtain adequate power and draw valid conclusions about any possible enhancements of using music during meditative movement exercises. A redesign of the study toward a within-subjects approach, such that all participants would be engaged with each of the music conditions, would allow for further comparisons and greater internal validity as each participant would serve as their own control. Also, the order of exercise sets presented should be counterbalanced to control for any potential exposure or learning effects. Because it would be unreasonable to control for and expect participants to use the same digital equipment (which would limit the ecological validity of the study) to access the study exercises, this information should be collected prior to the onset of the study to compare any potential differences between accessing the videos on phones, tablets, laptops, and so forth. Also, it would be important to make note of whether participants used headphones and if so, which type of headphones (earbuds, over the ear, wireless, etc.) or if they listened through speakers. Use of a high-quality microphone is recommended to deliver the best quality of music possible.

Longitudinal research could be conducted to study the long-term effects of meditative movement and music, for instance, changes over six to eight weeks of exercise rather than a single session. This would likely require the inclusion of outcome measures more appropriate for long-term rather than single-session changes. In the future, researchers could consider conducting the study in in-person and group sessions as implemented in the study by Pölönen et al. (2019).

CONCLUSION

Results indicated that the addition of music to qigong exercises is feasible, as it was acceptable and practical to the participants. Also, incorporating music into meditative movement has different effects on participants' affect and flow than meditative movement alone. The addition of recorded music to qigong exercises led to the largest overall change in mood and was positively valenced. Live music resulted in the smallest change, although still positively valenced. The use of live music with qigong exercises contributed to the largest increase in flow. These preliminary findings support the feasibility and scientific need for conducting a fully-powered study.

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DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, Lai Yiu Yeung, upon reasonable request.

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