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Perception of Congruence between Music and Movement in a Rhythmic Gymnastics Routine

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ABSTRACT

For sports that involve a routine or choreography, music is used either as a background sonic accompaniment or to enhance and synchronize the movement of the athletes. This paper aims to investigate the perception of congruence between movements and music in a rhythmic gymnastics routine from a musical perspective. Contrary to the conventional method of choreographing a routine based on selected music, this research aims to investigate the quality of the routine with existing choreography accompanied by a newly-composed music. A routine performed by a gymnast was recorded and music composed to match the existing choreography based on the recording. Fifty-two participants from a tertiary institution, all music majors, were asked to evaluate two videos which had the same rhythmic gymnastics routine, one with the athlete's original music and the other edited with the new music. The result shows that a significantly higher percentage of respondents chose the new accompaniment as having better congruence between the music and movement. Most of the respondents also perceived the new composition to be the original music used by the gymnast.

KEYWORDS: Music, congruence, movement, rhythmic gymnastics, routine

1. INTRODUCTION

Rhythmic gymnastics is one of the major sports that involve a routine and choreography with a selected music accompaniment. Other similar sports routines include figure skating, synchronized swimming, and martial arts that require a high level of acrobatic techniques but also show creativity and artistic elements. However, amongst these sports, rhythmic gymnastics has the closest association with music due to its origins and historical background. This can be traced back to the Swiss composer and music educator – Emil Jacques-Dalcroze, who introduced eurhythmics, also known as the Dalcroze method, relating rhythm and body movements, both entities he believed are the basis of music pedagogy and expressivity [1]. As well as rhythm, music is constructed from elements such as tempo, dynamics, articulation, expression, phrasing and so forth, which equally contribute to the synchronization of movements in a routine.

The relationship between music and sports has been the subject of different types of study and research. Much research deals with how music enhances ergogenic effects amongst sportsmen; normally this involves sports with repetitive movements such as running, cycling, aerobics and so forth [2,3,4]. These studies explored the changes in emotion and motivation when music is used during these exercises. Karagheorghis et al. (2010) and Terry et al. (2012) explain that there are two kinds of music used in sports; synchronous music is explained as the 'rhythmic and temporal aspects of music used as a type of metronome that regulates movement patterns', while asynchronous music is used to provide a 'background simulation without conscious synchronization between movement patterns and musical tempo' [4,5]. As these terms mainly refer to repetitive exercises, music accompaniment used for sports routines may be looked at a different perspective, which is simplicitly more complex as it involves musical style, mood, character, dynamics and others aspects to suit the choreography and the athlete.

Choreographed sports routines are also closely associated with dance, in which movements and elements are structured and planned. Similarly to repetitive exercises, dance or sports routines customarily employ music either as a background accompaniment or synchronized with body movements. The combination, communication and relationship between the two subjects indirectly raise discussion of congruence in the audio-visual perception of viewers and listeners. Interviews with some coaches in rhythmic gymnastics established that it is customary first for the selected music to be edited and the routine choreographed accordingly. This study explores the quality of congruence when a music accompaniment is composed based on an existing choreographed routine and not vice

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versa, as is the conventional method. A survey was conducted to investigate the perception of congruence regarding the routine and music from a musical perspective.

Music in sports routine

Music accompaniment in a sports routine is no doubt crucial to highlight the choreographed routine of a contestant. Most competitive routines are required to have music congruence, as stated in many competition regulations; for example, in the 2013 'Code of points' for rhythmic gymnastics, penalties are incurred for 'isolated occurrences when the rhythm and/or character and the music are disconnected' or '5 or more isolated interruptions or a large mistake which causes a large break in the rhythm and/or character of the exercise or the correlation is only in the beginning and end (not middle)'; in Rules of International Wushu Tao Lu Competition, 2005, it is stated that 'the competitor may choose a piece of music on his own to match the choreography'; and in FINA (Federation Internationale De Natation), music interpretation and use of music in choreography account for points in synchronized swimming (SS17 Judgment of routine).

Considering the many factors, including character, duration, mood, style, tempo and so forth, it is customary that coaches or athletes choreograph their routines based on the selected music. As Harman et al. (2009) stated in their article on figure skating, 'The choice of music becomes one of the most important decisions in developing a programme. […] The choice of music must enhance the skater's personality, talent and technical ability' [6:89]. From several interviews with athletes, while choreography is based on the selected music, sections of music may be edited through computer software to suit the duration or movement in the routine. Although synchronization with music is their objective, occasionally they have to compromise movements at certain sections of the music since it may not perfectly match all movements in the routine. Through reviews of videos, problems in the process of music editing in sports routines were observed, including smoothness in bridging tracks, sound quality, and interruptions to musical structures. Either because of an individual's musical background, preferences or other particular reasons, it was also observed that many of these routines do not entirely or not at all match the music. As stated by Harman et al. (2009:91) '[…] one has the feeling that the skaters would do the identical programme regardless of the music playing' [6:91]. However, this raises the questions of whether problems disturb the majority of viewers, and must also take into account the viewers' different backgrounds, which lead to different preferences and styles in perceiving these routines with music.

Congruence between movement and music

The issue of congruence between auditory and visual aspects was studied extensively in various fields. In music per se, many studies deal with the body gestures of musicians that provide function and communication in their performances [7,8,9,10,11,12]. This research mostly investigates listeners and viewers' perceptions of the expressions of performers [13,14]; and also identifies musical elements drawn from the physical movements of instrumentalist [15,16,12]. However, the research focused on the instrumentalists who themselves produce both movement and sound.

However, for dance, which has a context more similar to sports routines, where choreography is accompanied by music, various research found congruence was perceived by listeners [17]. An appropriate music that matches the routine is thus important, as is evident in Mitchell and Gallaher's research (2001), so that people can recognize a match between music and dance although they are temporally separated [18]. Choreomusical analysis, as discussed by Paul Hodgins (1992), also highlights the relationship between dance and music including structural organizations, dynamics, rhythm and qualities of motion [19].

The primary idea of this study, to experiment with a new approach to music accompaniment for sports routines, stemmed from the idea of film music. Some research regarding audio-visual perception of film music is thus relevant to sports routines, particularly those involving visual action or movement. Although in a different context, this can be found in some research which show the effect of background music directly affects the meaning of a geometric figure [20,21:29]. The study reveals that a computer-animated ball bouncing high and at a fast pace, termed as a 'happy' ball, was judged as less happy if matched with a slow and low melodic accompaniment. Relating to rhythmic gymnastics, this leads us to wonder if a sound or background music could enhance the visualization of a particular jump, turn or other elements. As rhythmic gymnastics demonstrates various acrobatic movements, together with different apparatus, the present study can also take into consideration the 'capture' effect as discussed in Fogelsanger and Afanador's article [22]. This derives from the McGurk or McDonald effect in 1976 in which a visual image can be altered by different auditory stimuli. This leads on to the bouncing-inducing effects described in the same paper as 'auditory capture', where visual perception is changed when it is combined with a different auditory stimulus. On the other hand, this may apply to rhythmic gymnastics, to explore the quality of

congruence in music affecting the momentum, or excitement, particularly catching or swinging apparatus, or for an acrobatic element.

Although congruence seems to be perceived by viewers, the principle of 'capture' also leads to research where music and dance not intended to be was similarly perceived as significantly congruent [18]. This derived from two dimensions where visual material influences people to perceive congruence in an auditory material which is termed as 'semantically congruent' [21]. Bolivar et al. interpreted this as 'visual capture' and gave an example in which people interpreted simultaneous 'friendly' music and videotapes of aggressive interactions as congruent. This was in contrast with 'auditory capture' [23,24] where auditory material dominates and influences people to perceive congruence in incongruence material. In the same research, [22:152] found that sound quality of audiovisual stimuli did not affect visual processing. Reason for the 'visual' and 'auditory' capture may possible come from the Gestalt principle of perception as viewers attempt to create a connection between two subjects even though relationships between music and dance are not intended [25]. The general principle of Gestalt, *prägnanz*, means that we tend to look for the regular, symmetrical and orderly rather than the irregular and the complex.

2. METHODS

Participants and routine

At a school gymnasium, the researchers selected a 14-year-old athlete who had 10 years' experience in rhythmic gymnastics. This gymnast has been involved in numerous competitions locally and abroad, and she was also a medallist in consecutive years. Her coach, who is responsible for the selection of music and choreography for the gymnast, was also included in this experiment. The procedure and the purpose of the study were explained to both the coach and the gymnast. The ribbon routine was chosen for this study as it was evaluated to have the most congruence between movement and music. At that time, the gymnast was preparing to participate in the Federation Internationale de Gymnastique (FIG) competition of junior category in Singapore 2011, which was to be held the following month. Therefore, the selected routine was considered well practiced together with the music. At the gymnasium, performances of the routine were recorded and the best recording was selected for this experiment. These performances were recorded using a Canon FS100 Mini DV Camcorder.

Composing a New Music Accompaniment

Before the new music was edited to the video, the routine was analyzed without music, including each movement, throwing and catching the apparatus, the style of the apparatus, jumps, steps, turns and so forth. The reason for this observation was to construct elements in the music in order to fit to every movement and step in the routine perfectly. This was examined using Logic pro8 and the music was composed using the same software. The style of the new composition kept to that of the original music, both of which use the style of a classical symphony orchestra, so as not to have too great a contrast with the original accompaniment. After the new accompaniment was completed, two videos of the same routine were prepared, one with the original music track used by the gymnast and the other with the newly-composed accompaniment. In consideration of the sound quality of the two videos, to avoid different quality of sound and to filter the noise environment of the original video, both the original and new music were edited and superimposed on the video recording of the original gymnastic performance.

A live performance of the gymnast to the new music was not recorded due to the duration of the study, as the gymnast would not have enough time to practice with it. As the gymnast had long practiced the routine using the original music and was in the process of preparation for competition, it was not reasonable to compare a performance to the new music with limited practice.

Respondents

Fifty-two undergraduate students (n=52) who are majoring in music at two tertiary institutions were invited to participate in this survey. The survey was conducted after lecture courses and the duration was approximately 20 minutes. These students were aged between 20 and 22 years and were trained with a Western musical background for at least 10 years. Each subject was given a questionnaire and the purpose of the study was explained. The respondents were asked if they understood all the terms and questions in this survey before watching the video presentation. The two videos, featuring the same ribbon routine with different music, were shown using a projector and the respondents watched one the other. This was followed by the respondents completing the questionnaire.

Questionnaire and procedure

Generally, respondents were asked to choose which video they thought best match the criteria in answer to various questions. Respondents could opt to choose 'both are the same' if they felt that both videos had a similar quality. The reason for having simple answers was to avoid overly conservative ratings amongst the subjects and to

encourage a spontaneous response in terms of the subjects' evaluation. Twelve questions in this survey were made as general as possible and categorized into three sections: firstly, questions about congruence between apparatus and music; secondly, regarding the expression of the performance; and thirdly, the gymnast's performance and congruence between the movement of the gymnast and music.

Twenty-six viewers watched the video with the original music followed by the video with new music, and the order was changed for the other twenty-six viewers. The reason was not to have an irrational primacy effect in this study, avoiding biased opinion or interpretation for items appearing earlier in a series. Another two questions were asked after the respondents had completed their questionnaire. Firstly, they were asked if the gymnast performed twice – once with her original music and again with new music – or performed only once, with the music edited to the video. The second question asked which was the original music used by the gymnast. These questions were only revealed after the survey to avoid any interruption or biased interpretation in the evaluation of the study.

3. RESULTS AND DISCUSSION

Movement of ribbon and music

The use of different apparatus provides a significant character in each routine. From the many observations of videos that demonstrate different routines with the five standard types of apparatus, it was found that the correlation between the music and the apparatus movements or direction contributes greatly to the congruence between the routine and music. From a musical perspective, a few significant observations include the momentum of swinging an apparatus, catching and patterns formed by an apparatus. The common patterns formed by the ribbon include flicks, circles, snakes and spirals. From observation of the routine in this study, the only synchronization between the ribbon and movement occurred with the piano arpeggios and running notes in the melodic line of the music. These music figures may function to portray the ribbon curls executed by the gymnast's hand movements. However, there seemed to be no musical significance when the gymnast swung and tossed the ribbon, nor when the gymnast caught the ribbon. The most congruence shown in this context was with the ribbon toss towards the end of the routine which was also the climax of the music.

In the new music accompaniment, we experimented with a few approaches to produce more congruence between music and movement in the use of the ribbon. This included taking into consideration particularly the pattern generated, the swing-throw movement and the catch. For example, trills of the flute tinted with glockenspiel were used to accompany circles or spiral movement of the ribbon; a running harp passage was used to portray the snake pattern; and accents within the melodic line were employed to show the flicks and the hand movement of the gymnast. The momentum of the high ribbon-throw which occurred twice near the end of the routine was accompanied by a mounting of a series of sequences from the melodic pattern, with a crescendo rising up to the climax. The timpani, ending with a cymbal crash to provide a cadence, were also used to match the point where the gymnast throws and swings up the ribbon.

From the evaluation of the two videos, one with the original music (V1) and the other with a new accompaniment (V2), 71% of the respondents thought that the video with new music accompaniment (V2) demonstrated more directions for the acrobatic movements such as the throw and catch of the ribbon, while 25% perceived that both videos had the same quality. In terms of the momentum of the throws and catches of the ribbon, 88.5% rated V2 in as having better congruence (refer to Figure 1).

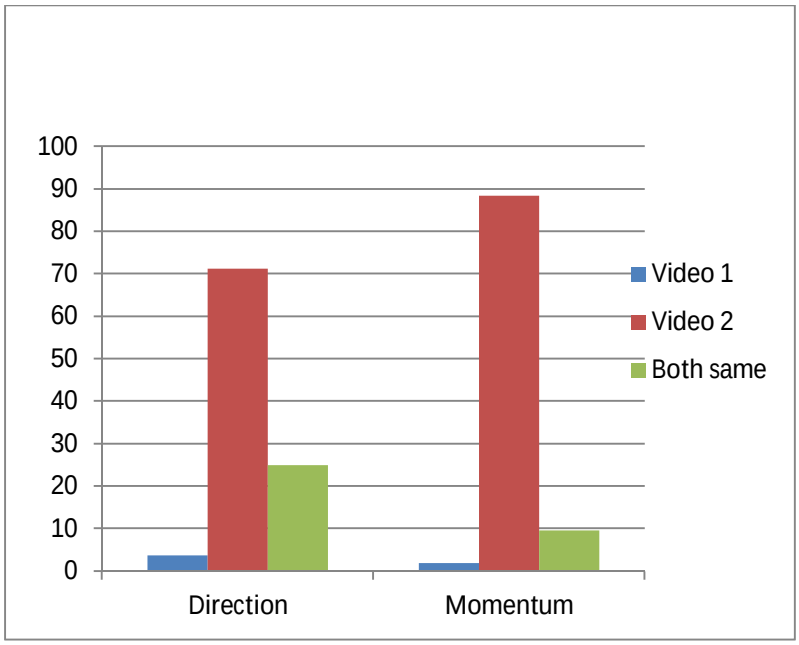

Figure 1. Congruence between movement and apparatus and music

Expressions of movement and music

From discussion with the coach, the music chosen for a gymnast is also based on the individual character as well its suitability for the choreographed routine. The coach explained the gymnast in this study has a serious character, always with a more stern facial expression. Therefore, this inevitably affects the choice of music by the coach's choice of music in the initial stage of choreography of a routine. Expression in this context means the communication and the character between the two domains. In a brief explanation, the dance character of the original music carries a strong pulse in triple time in a minor key, occasionally modulating to the major but only for a short fragment in a waltz-like rhythm. In contrast, the new accompaniment was written in 4/4 time but similarly in minor key, although it later modulates and ends in the major.

The survey asked about the overall expression of the gymnast's movements corresponding to the music and also which music had a better match with the expression of the gymnast. A total of 73.1% of subjects rated V2 as more expressively performed than V1, which scored 7.7%. For the other question, 88.5% felt that the music in V2 was a better match to the expression of the gymnast and 7.7% rated both videos as the same (Figure 2).

Congruence between movements and music

From observation of the overall routine, congruence between movements and music can be derived from many aspects, including rhythm and tempo, structure, momentum, climax, direction and so forth. The analysis of congruence between the two domains could be rather complex and subjective, taking into account the preferences of individual, with their various backgrounds such as training in music, dance or sports. Therefore, this study reports eight questions regarding the issue of congruence between the movements and music; two questions were asked about the momentum and climax of the routine; two questions asked the subjects to choose which performance showed a more energetic gymnast and exciting acrobatic movements; three questions were asked about details of the accompanying music, including phrasing, tempo and appropriateness; and the overall congruence between movements in the routine and music was questioned.

The consistent pulses in the original music which provide a clear rhythmic pattern thus contribute a good choice as a dance routine. However, it was observed that many phrasings in movements or steps did not align with the phrasing in music. For instance, the beginning of a particular element from a series of steps preceded by jumps, or the beginning of a turn with circling of the apparatus was initiated within a musical phrase which had no significance. In short, many of the starts and ends of movements or steps did not correlate with the phrasing of the music. Despite phrasing, the three jumps in the routine, including straddle and stag jumps, were visually significant to the viewers in general. The momentum and direction from steps leading to these jumps were also visually apparent. However, similar to the use of apparatus such as throws, catches or different patterns from the ribbon, the

jumps in this routine did not reflect any elements in the accompanying music. There was also no musical significance to the direction of a particular jump or when the jumps were executed. It was observed also that one of the jumps occurred during the resolution of a phrase with a decrease in dynamics. One wonders if such contradiction with the musical elements was intended or whether there are other reasons for such interpretations. From the overall observation, however, three positions were found to show congruence between movement and music. The first was an element including a few steps followed by a short leap; the step did start at the beginning of a phrase and was followed by an accent which emphasized the leap. The other two occurred at the last throw-catch of the ribbon near the end of the routine; the throw-swing of the ribbon was accentuated at the end of the ascending figure, which was developed from a sequence in crescendo reaching a climax; the catch of the ribbon also correlated to the accented pulse in the music.

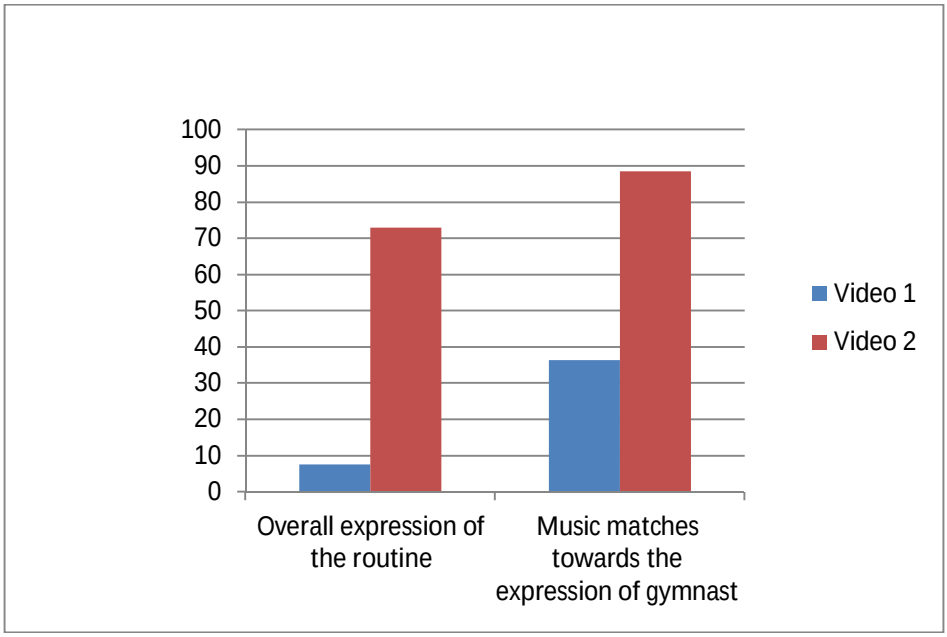

Figure 2. Congruence between expression of movement and music

Following analysis of movement and music in the original music used by the gymnast, as mentioned earlier, the new accompaniment was designed to have each movement perfectly congruent with the musical details. In general, apart from the execution of apparatus explained above, in which musical details were added to highlight the acrobatic movements, one of the main concerns was to align the structure and phrasing of the music with the movement. This took into account the initiation and termination of each movement, for example the beginning of a series of steps, skips or runs, or the beginning of a turn. Musical details were also included to highlight certain hand movements according to a particular pitch or rhythm.

In the survey, in rating which videos had more momentum regarding to the gymnast's movements, 92.3% of the respondents chose V2 with the new accompaniment. As for which video had the more convincing climax, V2 achieved a significant score of 90.4% (Figure 3). Regarding the congruence shown between the phrasing in the music and specific movements in the routine, 67.3% of respondents preferred V2 while 25% felt both videos were the same. Regarding the tempo used in the music accompaniment, 94.2% of the subjects felt that V2 had a more suitable musical tempo for the routine (Figure 4). Looking at the overall performance, 86.5% of respondents considered V2 demonstrated a more energetic gymnast and 78.8% felt that V2 showed more exciting acrobatic movements (Figure 5). As to which video had the more appropriate music, V2 recorded 84.6%, while for the video showing more overall congruence between music and routine, V2 again achieved a higher percentage of 84.6%.

Based on the survey, it is evident that a significantly higher percentage of respondents thought V2 with the new music accompaniment showed more congruence than V1 with the original music by the gymnast. At the end of the survey, subjects were also asked if they could recognize which video had the original music. Parallel with their choice for the above questions on congruence, 82.7% subjects thought V2 had the original music used by the gymnast. This also corresponded to the question of number of performances; where 73.1% subjects thought that the gymnast performed twice, once with the original music and again using the same routine with the new

accompaniment. This also means that the perception of congruence observed by the subjects affected their recognition of the original performance of the gymnast.

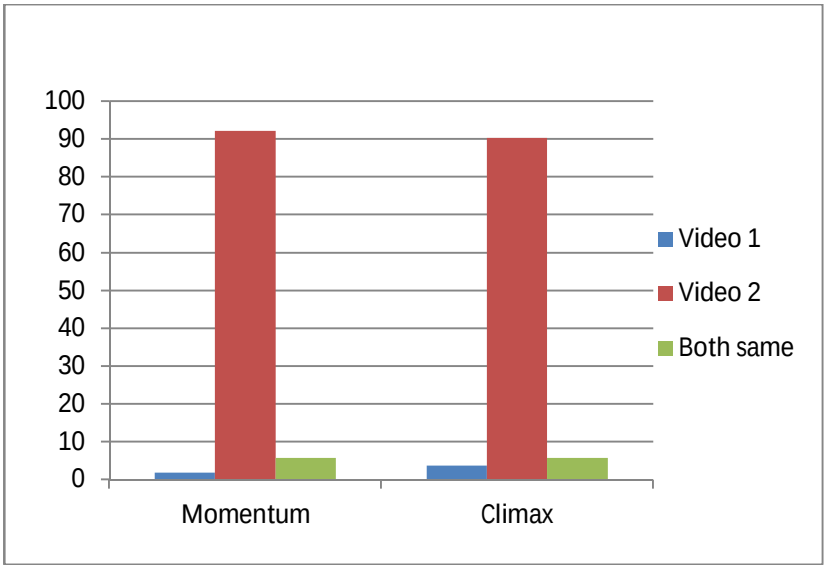

Figure 3. Congruence between momentum and climax of movement and music

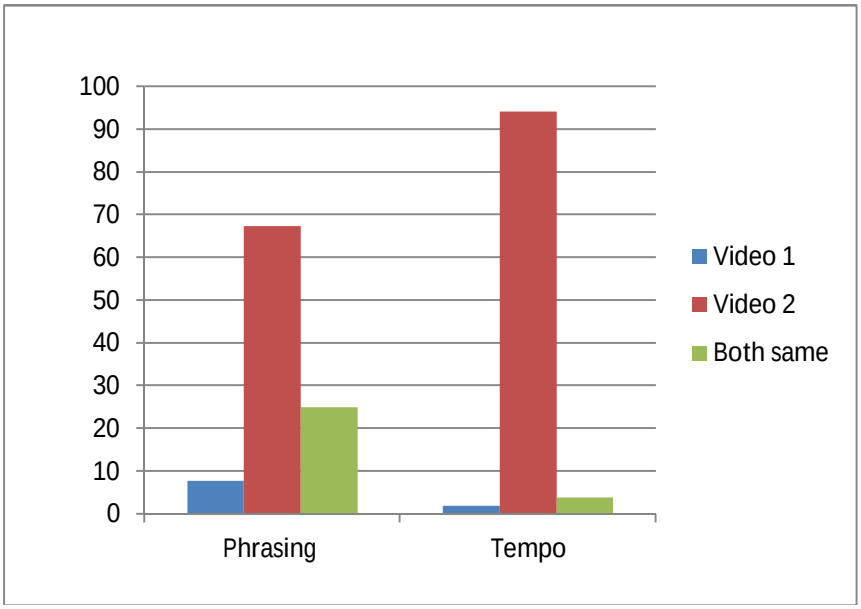

Figure 4. Musical phrasing and tempo towards the movement in routine

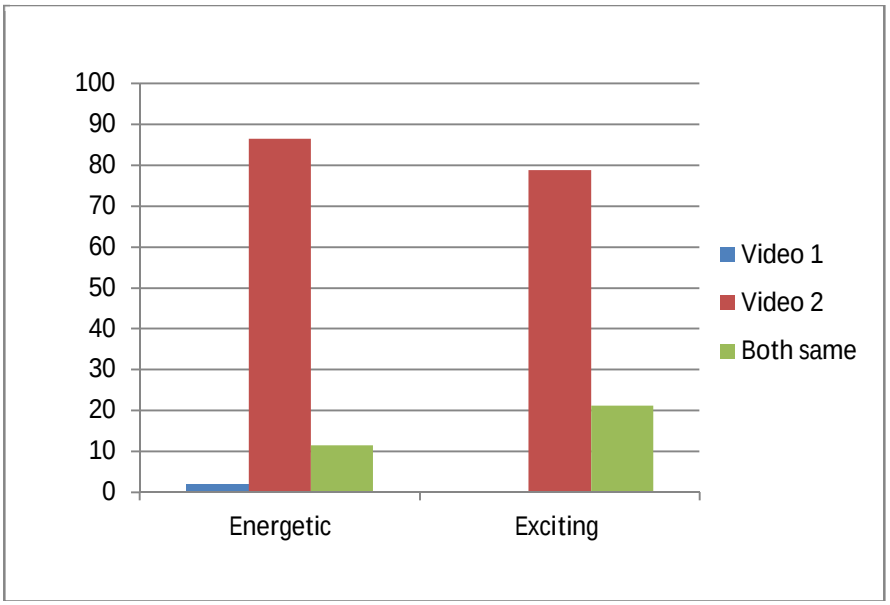

Figure 5. Video shows more energetic gymnast and exciting routine

Perceptions of congruence and influences between audio and visual aspects have long been investigated in various fields, particularly in film [20,23,21,26] and dance [17,18]. While the present study lies in the field of sports and music, there exist many similarities in terms of movement, choreography, music, and communications, and more importantly these competitive routines involve viewers. This experiment, using a new accompaniment together with a survey, proves that the intended congruence between music and movement is clearly perceived by viewers with a musical background. Using the same routine and video, the visualization of the movements in terms of momentum, climaxes, and expressions in general, was also enhanced by the change in music accompaniment. This means that the 'capture' of visual movements such as jumps, catching and throwing of apparatus, turns and so forth were enhanced by the change of music. Although the 'capture' effect [23,21,24] indicated that 'music can sometimes induce the feeling of congruence with incongruent visual stimuli' [18:80], the obvious recognition of congruence between the auditory and visual in this study supports the research of Mitchell and Gallahar (2001:81) [18:81], that participants were aware of 'common characteristics distinctive to particular music/dance combination and that they were better able to detect significant commonalities when they could compare among alternatives'.

Further research should be conducted in which the new compositions are used or performed live with gymnasts, in which the same routine with a new accompaniment is required to be practised to examine the effectiveness of the approach. However, this depends greatly on a few aspects which can sometimes be complicated. Firstly, this concerns the musicality of the athletes where music is not a criterion in the respective field [6, 27]. While the musicality of the athletes is not granted, this study is intended to enhance the musicality presented in the overall routine, regardless of the musicality of the gymnast per se. This approach may also lessen the limitation of the choreography being 'restricted' to the music. Secondly, the familiarity of gymnasts and coaches with the original music used in a routine over a long period of training may be difficult to challenge. In terms of familiarity, the question is whether a certain music or musical genre is specifically used in a particular sports routine. For example, should sports activities with slow movement as in taichi, or practices such as qigong or meditation [28] that require minimal movements be restricted to calm and slow music is worth to discuss. Although coaches stated that they are not restricted to any particular kind of music, it is noticeable that certain music is preferred and they were recurring in competitions throughout the years. While this needs to be examined further, the current approach may lead to producing a more individual routine with sonic accompaniment. In addition, congruence between movements and music in choreography can be furthered analyzed with details elements in music such as articulation, dynamic and phrasing [29].

4. CONCLUSION

This is a preliminary research in examining the quality of congruence between a sports routine and the musical accompaniment. From the survey, using the same routine, the new accompaniment for the routine was found more

congruent, as perceived by subjects with a musical background. This includes congruence in terms of the use of apparatus, overall expression, momentum, climax and overall movement to the music. Viewers were able to discern the quality of congruence due to the change of music accompaniment. In short, the change of audio affected the viewers' perception of the original performance; the performance appeared more congruent with the new music accompaniment. The change of music also resulted in viewers not recognizing the original accompaniment from the videos presented, leading many of them to perceive that the gymnast performed twice with different accompaniments. However, we must take into consideration that the study only involved subjects with a musical background, and the expertise of these respondents may affect their perception of the routine as a whole. Therefore, in future the study aims to investigate the perceptions of subjects with different backgrounds, particularly those involved with dance or movement-based activities, and those of a public audience who have no training in music or dance.

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