

KINEMATIC ANALYSIS OF MUSIC'S INFLUENCE ON BODY EXPRESSION



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ANÁLISE CINEMÁTICA DA INFLUÊNCIA MUSICAL SOBRE A EXPRESSÃO CORPORAL

ANÁLISIS CINEMÁTICO DE LA INFLUENCIA MUSICAL EN LA EXPRESIÓN CORPORAL

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ABSTRACT

Introduction: Dance is a combination of strength and beauty. Improving the expression of body movements in dance can improve the artistic quality of the performers and provide a greater visual experience to its spectators. **Objective:** Explore the influence of music on dancers' upper limb movement expression through kinematic analysis based on movement mechanics. **Methods:** The factors influencing the expression of body movements and sports training in the dance process were investigated via a questionnaire. A group of 20 volunteers performed a movement performance only through a specific rhythm, while the experimental group combined the full music with the dance moves. After a set of four dance movements, the completion time, trajectory length, speed, and acceleration of the upper limbs were recorded and rated, analyzing the fluency of the two movement groups. **Results:** Dance movement does not interfere as much with the rhythmic control of professional dancers; however, it impacts their fluency, range, and motion. **Conclusion:** With the cooperation of music, the dancers' movements were more harmonious and smoother, bringing a better expressive effect to the upper limbs. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Biomechanical Phenomena; Music; Dancing.

RESUMO

Introdução: A dança é uma combinação de força e beleza. Aprimorar a expressão dos movimentos corporais na dança pode melhorar a qualidade artística dos intérpretes e proporcionar uma maior experiência visual aos seus espectadores. **Objetivo:** Explorar a influência da música na expressão dos movimentos dos membros superiores de dançarinos, por análise cinemática baseada na mecânica do movimento. **Métodos:** Os fatores de influência da expressão dos movimentos corporais e do treinamento esportivo no processo de dança foram investigados via questionário. Um grupo de 20 voluntários efetuou uma performance de movimento apenas através de um ritmo específico, enquanto o grupo experimental combinou com a música completa ao movimento de dança. Após um conjunto de quatro movimentos de dança, o tempo de conclusão, o comprimento da trajetória, a velocidade e a aceleração dos membros superiores foram gravadas e classificadas, analisando a fluência dos dois grupos de movimento. **Resultados:** O movimento da dança não interfere tanto no controle rítmico dos dançarinos profissionais, porém tem impacto na fluência e na amplitude e movimento dos bailarinos. **Conclusão:** Com a cooperação da música, os movimentos dos dançarinos mostraram-se mais harmônicos e suaves, trazendo um melhor efeito expressivo aos membros superiores. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Fenômenos Biomecânicos; Música; Dança.

RESUMEN

Introducción: La danza es una combinación de fuerza y belleza. Mejorar la expresión de los movimientos corporales en la danza puede optimizar la calidad artística de los intérpretes y proporcionar una mayor experiencia visual a sus espectadores. **Objetivo:** Explorar la influencia de la música en la expresión de los movimientos de las extremidades superiores de los bailarines mediante un análisis cinemático basado en la mecánica del movimiento. **Métodos:** Se investigaron mediante un cuestionario los factores que influyen en la expresión de los movimientos corporales y el entrenamiento deportivo en el proceso de la danza. Un grupo de 20 voluntarios realizó una actuación de movimiento sólo mediante un ritmo específico, mientras que el grupo experimental combinó con la música completa el movimiento de baile. Tras un conjunto de cuatro movimientos de danza, se registraron y clasificaron el tiempo de finalización, la longitud de la trayectoria, la velocidad y la aceleración de los miembros superiores, analizando la fluidez de los dos grupos de movimientos. **Resultados:** El movimiento de la danza no interfiere tanto en el control rítmico de los bailarines profesionales, pero sí repercute en la fluidez y la amplitud de movimiento de los bailarines. **Conclusión:** Con la colaboración de la música, los movimientos de los bailarines se mostraron más armoniosos y suaves, aportando un mejor efecto expresivo a los miembros superiores. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Fenómenos Biomecánicos; Música; Baile.



INTRODUCTION

The influence of dance music on the expression of body movements is mainly reflected in the traditional dance competition performance, or in the sports dance competition with stronger sports competitiveness, the players or athletes express their emotions through their body language and facial expressions, and the rendering of the music atmosphere.¹ Dance movements, emotions and atmosphere are integrated and unified. Dance movements show the players' physical coordination ability, strength, beauty and competitive level.² Music determines the internal theme of the players' performance. The rhythm of music affects every dance action of the contestants. The contestants bring the music from intangible to tangible transformation through dance, and the dance project is the perfect combination of music and sports.³ The evaluation standard of players' level is through the comprehensive evaluation of sports competitive ability and artistic expression. So far, great progress has been made in the development of projects in China, and the gap between China and other countries with high dance level has gradually decreased. After professional art training, players improve their artistic expression, which plays a vital role in the achievement of dance projects. Therefore, colleges and universities should carry out dance related courses to cultivate the level of physical and artistic expression of college students, so that they have a good sense of body rhythm and rhythm. Choosing appropriate music and designing appropriate dance movements is an important link to achieve excellent results in competitive dance competitions.⁴ The popularization of colleges and universities is conducive to the development of college students in many aspects, such as art and sports, to improve their artistic level, to improve their physical health level and to improve the comprehensive quality level of the students, which meets the needs of the times and is beneficial to the physical and mental development of students.⁵ Dance is the combination of strength and beauty. Good body movement training and appropriate music matching can make the expression of dance movements smoother. Therefore, this paper discusses the strategies to improve the expression of body movements from the two aspects of sports mechanics and dance music.

METHOD

This paper conducted a questionnaire survey on students majoring in dance in several colleges and universities, including the influencing factors of body movement expression and sports quality training in the process of dance. The research methods include online questionnaire survey, offline questionnaire survey and interview. A total of 371 questionnaires were collected, 9 invalid answers were excluded, and 362 questionnaires were obtained. The study and all the participants were reviewed and approved by Ethics Committee of Hunan Normal University (NO.18HNNU096). The data were entered and analyzed. In this experiment, 40 subjects were randomly divided into two groups by lot, including 20 subjects in the experimental group and 20 subjects in the control group. In order to explore the influence of dance music on the expression of limb movements, this paper takes motion mechanics as the judgment standard. The control group does not use music, but only completes the movement display through the password beat. The experimental group is matched with the relevant music of the dance movement. By completing a group of dance movements including chest flexion, shoulder flexion, chest flat flexion and down lift, the completion time, arm trajectory length, arm speed The arm acceleration and so on were sorted out and recorded, so as to judge the fluency of the two groups of movements.

The mathematical statistics of this paper includes two parts. Firstly, the questionnaire survey results are sorted, entered and analyzed, the relevant contents are classified by Excel software, and the images are

drawn in the form of pie chart to make the experimental results clearer. The data obtained by the experimental method were analyzed by Excel software and SPSS software. The independent variance t-test was used, $P < 0.05$, indicating that there was a significant difference.

RESULTS

Influencing factors of limb movement expression

As shown in Figure 1, in the student investigation and Research on the influencing factors of limb movement expression, 78 people think that the influence of sports quality is the most important, accounting for 21.547%; 108 people thought that the influence of artistic cultivation was the most important, accounting for 29.834%; 54 people thought that the influence of psychological level was the most important, accounting for 14.917%; 33 people think that the influence of cultural heritage is the most important, accounting for 9.116%; 44 people thought that the influence of teachers' teaching ability was the most important, accounting for 12.155%; 45 people thought that teamwork was the most important, accounting for 12.431%. It can be seen that among the factors affecting the expression of these movements in dance, the first is artistic cultivation, and the second is sports quality.

As shown in Figure 2, in the student investigation and Research on the influencing factors of sports quality training, 59 people think that the influence of strength factor is the most important, accounting for 16.298%; 124 people thought that flexibility was the most important factor, accounting for 34.254%; 44 people thought that the influence of endurance factor was the most important, accounting for 12.155%; 33 people thought that the influence of speed factor was the most important, accounting for 9.116%; 102 people thought that the influence of coordination factors was the most important, accounting for 28.177%. It can be seen that among the sports quality training factors related to dance movements, flexibility factors and coordination factors are the highest, which is also related to the characteristics of dance movements. Body movements are shown through the dancer's flexible limbs, while coordination factors make the whole body movements look more smooth. The third factor is strength. Adding strength to flexible and smooth movements can make dance movements more infectious and show the characteristics of the combination of strength and beauty.

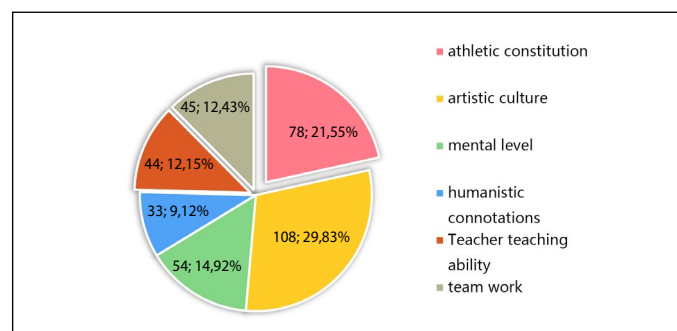


Figure 1. Influencing factors of limb movement expression.

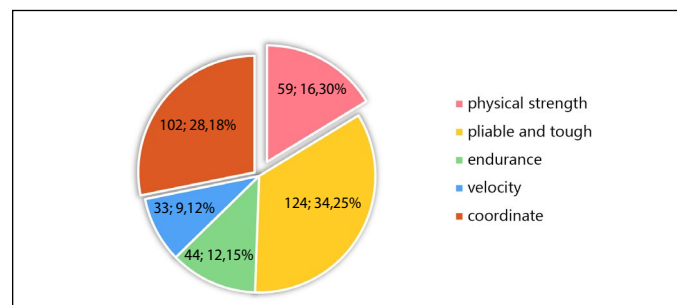


Figure 2. Influencing factors of sports quality training.

Analysis of dance limb movements based on motion mechanics

The participation of dance music can make the expression of limb movements smoother. Therefore, this paper takes sports mechanics as the judgment standard, and analyzes the effect of limb movement expression by comparing the fluency of relevant movements completed by the experimental group and the control group with or without the support of dance music.

As shown in Table 1, during the completion of chest flexion, the time spent in the experimental group was (0.4944 ± 0.036) s and that in the control group was (0.4918 ± 0.046) s, $P > 0.05$, indicating that there was no significant difference; In the process of shoulder flexion, the time spent in the experimental group was (0.4708 ± 0.056) s and that in the control group was (0.4748 ± 0.058) s, $P > 0.05$, indicating that there was no significant difference; During the completion of chest flexion, the time spent in the experimental group was (0.4916 ± 0.046) s and that in the control group was (0.4864 ± 0.078) s, $P < 0.05$, indicating that there was a significant difference; In the process of lifting down, the time spent in the experimental group was (0.4956 ± 0.040) s and that in the control group was (0.4918 ± 0.034) s, $P > 0.05$, indicating that there was no significant difference.

As shown in Table 2, during the completion of dance movements, the track length of the experimental group was (4.1940 ± 0.314) m, and the relative track length was (2.4526 ± 0.219) m, $P < 0.05$, indicating that there was a significant difference; The track length of the experimental group was (3.8458 ± 0.232) m and the relative track length was (2.2327 ± 0.185) m, $P < 0.05$, indicating that there was significant difference. By comparing the two groups, it can be seen that the arm trajectory length of the experimental group is slightly longer than that of the control group, which proves that in the whole dance limb movements, the experimental group is more stretched against the background of music, so the movements are also more beautiful.

As shown in Table 3, when the chest flexion is completed, the instantaneous speed of the experimental group is (-3.9322 ± 0.572) m / s and that of the control group is (-3.7409 ± 0.567) m / s, $P < 0.05$, indicating that there is a significant difference; The acceleration of the experimental group was (-12.6860 ± 6.168) m / S² and that of the control group was (-11.5121 ± 4.296) m / S², $P < 0.05$, indicating that there was a significant difference. When the shoulder flexion was completed, the instantaneous speed of the experimental group was (-1.6017 ± 0.541) m / s and that of the control group was (-1.3112 ± 0.431) m / s, $P < 0.05$, indicating that there was a significant difference; The acceleration of the experimental group was (-7.1861 ± 3.856) m / S² and that of the control group was (-6.6247 ± 3.715) m / S², $P < 0.05$, indicating that there was a significant difference. When the chest flexion was completed, the instantaneous speed of the experimental group was (-2.6500 ± 0.904) m / s and that of the control group was (-2.5410 ± 0.516) m / s, $P < 0.05$, indicating that there was a significant difference; The acceleration of the experimental group was (-11.2085 ± 7.035) m / S² and that of the control group was (-9.5558 ± 4.312) m / S², $P < 0.05$, indicating that there was a significant difference. At the completion of the lifting movement, the instantaneous speed of the experimental group was (-1.6767 ± 0.651) m / s and that of the control group was (-1.5553 ± 0.348) m / s, $P < 0.05$, indicating that there was a significant difference; The acceleration of the experimental group was (-5.6967 ± 2.623) m / S² and that of the control group was (-6.4098 ± 2.372) m / S², $P < 0.05$, indicating that there was a significant difference. Through the comparison between the two groups, it can be seen that when the action is completed, the speed and acceleration of the control group are slightly lower than that of the experimental group.

Table 1. Completion time of dance movements (s).

Group	Chest flexion	Shoulder flexion	Chest flexion	Lift down
Control	0.4944±0.036	0.4708±0.056	0.4916±0.046	0.4956±0.040
Test	0.4918±0.046	0.4748±0.058	0.4864±0.078	0.4918±0.034
t	0.0030	-0.0040	0.0040	0.0020

Table 2. Arm track length at the completion of dance movement (m).

Group	Track length	Relative track length
Control	4.1940±0.314	2.4526±0.219
Test	3.8458±0.232	2.2327±0.185
t	0.3524	0.2173

Table 3. Arm speed at the completion of dance movement.

	Group	Chest flexion	Shoulder flexion	Chest flexion	Lift down
Δv (m/s)	Control	-3.9322±0.572	-1.6017±0.541	-2.6500±0.904	-1.6767±0.651
	Test	-3.7409±0.567	-1.3112±0.431	-2.5410±0.516	-1.5553±0.348
	P	-0.1952	-0.2954	-0.1121	-0.1264
\bar{a} (m/s ²)	Control	-12.6860±6.168	-7.1861±3.856	-11.2085±7.035	-5.6967±2.623
	Test	-11.5121±4.296	-6.6247±3.715	-9.5558±4.312	-6.4098±2.372
	t	-1.3463	-0.5427	-1.6079	0.7184

Through the overall analysis of the dance limb movements measured by the sports mechanics index, it can be seen that for professional dance performers, the presence or absence of dance background music will not affect the control of their beat, but will significantly affect the stretching degree and speed of their movements. In terms of visual effect, dancers with dance background music will perform more comfortably and smoothly, while dancers without background music will appear slightly restrained and not beautiful.

DISCUSSION

Dancers are the carrier of expressing dance works. Contestants express the theme of their works through technical movements, and excellent dancers can perfectly show their works in front of the audience. The core is body language movements. There are many factors that affect the perception of body language movements, including time and space of performance, strength and flexibility of performers, body coordination ability and other comprehensive abilities of body functions. The criterion for judging whether the action is beautiful or not is to achieve the standard of action, perfect combination with music and comply with the rules of the competition. Therefore, the design of dance movements should be based on the existing scientific knowledge, in line with human structure, human function, biology and sports anatomy, so as to improve the feasibility of movements. We should also innovate the action, and constantly improve and innovate the action on the basis of the existing technical action. Reasonable design of technical movements can make the dance works express in a hierarchical manner, show the beauty of limbs, and express many human body aesthetic parts such as the sense of strength, rhythm and rhythm. Each action should be arranged layer by layer, and various factors such as the time and place of the performance should be considered in an all-round way. There should be logic between technical actions, smooth connection, stretch and beautiful posture. In dance teaching, we should give priority to targeted training for students' physical quality, so that students can show the technical movements of works and design appropriate technical movements for students.

CONCLUSION

Through the experimental research on the influence of dance action on limb expression by taking sports mechanics as the judgment index, it can be seen that dance music will not have too much

impact on the performer's beat control, but will significantly affect the fluency and stretch of action. Good dance music support can make the dancer appear more relaxed, more energetic and smoother in the performance process, so as to bring a good experience of strength and beauty. This is reflected in the daily teaching, we should be good at using the auxiliary methods of music, select the appropriate music

and design the appropriate actions, so as to improve the sense of rhythm and rhythm of limb movements and achieve better expression effect of limb movements.

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