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Entrainment in ballroom dances: The influence of the pair in the synchronization with the music

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In personal interactions, such as ballroom dances, there is an element of competition tending to keep the rhythm of each element of the pair (*maintenance tendency*), as well as a component of cooperation (*magnet effect*) and attraction by the rhythm of the other. Not everyone has the same ability to synchronize their movements with timekeepers, such as musical beats. In this study we intended, in a first phase, to measure this ability to change the *spontaneous motor tempo* (SMT) to synchronize the movements of ten different styles of dance with the tempo imposed by a metronome (*compulsory motor tempo*; CMT). Then we intended to verify the influence of the other, in experienced pairs, in the synchronization of the CMT. The results indicated that male participants presented higher SMTs than the female members of the same pair and higher values in *Latin* styles relative to *standard* styles. For the central objective of the study it was found that couples tended to help one another positively when synchronizing with the CMT, with a decrease of 9% of individual mistakes and 18% of mistakes per couple.

Keywords: entrainment; ballroom dances; spontaneous motor tempo; synchronization; interpersonal coordination

To dance at a professional level requires several physical and psychological capacities. Among them are coordinative abilities (rhythm, balance, spatial orientation, etc.) and the capability to synchronize movements with timekeepers, such as musical beats. Ballroom dances are always performed in pairs, demanding interpersonal coordination capacity and the entrainment of two people to perform the same motor task. For many authors, such as Brown *et al.* (2006), dance movement generally mirrored the hierarchical arrangement of strong and weak beats found in musical rhythm patterns. But this

situation does not arise when dancers dance without music, being forced to find their own rhythm internally, in the absence of an external sound stimulus. Igor Stravinsky spoke of the need for choreography to realize a form independent of that of music, while still being measured against it (Craft 1934). From his work with choreographers he conceived the idea that movement was structured independently of music. There seems to be evidence that, regardless of musical structure, we all have a spontaneous motor tempo (SMT): a person's preferred rate of moving (walking, running, tapping, dancing); a comfort zone, expressing an individual tempo to perform motor tasks. The main objectives of the present study focused on the assessment of the capacity of each participant to get away from their SMT (measured without any sound) and to synchronize with a required metronome tempo (CTM), in a range between 95 and 155 bpm, executing the basic steps of each of the ten ballroom dances that are part of international competitions. Then we sought to determine the influence (positive, negative, or neutral) of the pair in the performance of that task.

METHOD

Participants

The sample consisted of 12 (6 female, 6 male) competitive level ballroom dancers (professional and pre-professional). The average age was 25.92 years (SD=4.32), ranging between 21 and 33 years. The average dance experience was 9.17 (SD=3.99) years, with a minimum of 5 and maximum of 17. On average pairs danced together for 4.67 (SD=1.97) years. The criteria for sample selection were the experience of regular participation in international competitions, the practice of the ten styles of ballroom dances (*standard* and *Latin*), and a minimum of three years of work with the same pair.

Materials

In this study a digital metronome (EMT-888) was used to impose different tempos as well as a digital video camera (Panasonic Model No. NV-GS60E) to record the performances.

Procedure

Participants were asked to dance ten ballroom dances in front of a camera without any sound (SMT). After that, subjects were asked to follow the tempo imposed by the metronome for each dance (CMT), as solo and in pairs. Three observers (experts in dance) identified the SMT by watching the collected

images and adjusting the metronome to match. In a second phase the observers analyzed the images taken with CMT to assess individual and paired performances and choose one of three possible conditions for each of the ten dances: synchronized, faster, or slower.

RESULTS

Regarding the average for the ten individual dances studied, the SMT ranged between 96.40 (SD=15.31) and 103.60 (SD=14.59) bpm, *rumba* being the slowest (M=79.41, SD=3.42) and *jive* the fastest (M=124.91, SD=5.46). *Waltz*, *foxtrot,* and *tango* showed low values (M=84.58, SD=3.94; M=84.75, SD=5.02; M=86.83, SD=4.70) and the remaining five dances were much higher: *paso doble* (M=101.66, SD=2.36), *samba* (M=105.50, SD=3.23), *cha-cha-cha* (M=105.66, SD=3.77), *quickstep* (M=106.50, SD=5.00), and *Viennese waltz* (M=107.75, SD=4.99), though still far from the *jive* values. Two clear tendencies were observed when comparing the two groups of dances and tempos of each subject in relation to its pair. The masculine partners always presented higher tempos than his female pair (see Table 1), with the average value of this difference equaling 3.71 bpm. All subjects showed higher values in *Latin* dances compared with the *standard* dances, retaining the previous intra-pair difference for all the cases.

Table 1. Spontaneous Motor Tempos in bpm (SD), without metronome.

	10 styles	*5 Latin styles*	*5 standard styles*
M 1	99.10 (12.58)	99.40 (14.36)	98.80 (12.24)
F 1	96.70 (13.70)	99.20 (14.89)	94.20 (13.61)
M 2	100.00 (14.97)	104.00 (17.23)	96.00 (12.94)
F 2	97.40 (14.18)	102.60 (15.37)	92.20 (12.19)
M 3	100.30 (14.39)	106.40 (16.50)	94.20 (10.03)
F 3	96.40 (15.31)	102.60 (18.06)	90.20 (10.26)
M 4	103.60 (14.59)	107.20 (18.50)	100.00 (10.22)
F 4	97.00 (16.32)	104.60 (16.83)	89.40 (13.11)
M 5	100.40 (15.59)	106.60 (17.11)	94.20 (12.56)
F 5	97.40 (14.71)	103.00 (16.05)	91.80 (12.30)
M 6	100.30 (15.30)	104.60 (15.84)	96.00 (15.17)
F 6	96.50 (15.28)	101.00 (16.36)	92.00 (14.40)

The values of CMT (with metronome) were higher (on average 25.75 bpm greater) than the ones presented for the SMT, but similar to those found in the world champions of recent years. Most of the participants (46%) had difficulty in getting out of their comfort zone, presenting an execution closer to the SMT than to the value requested in the CMT condition. In Table 2 we can see the results of the analysis carried out by experts for solo and pair situations. In general we can see that the presence of the other has reduced the mistakes, helping to fulfill the task of synchronizing with the CMT. With the help of the pair the individual mistakes decreased 9%, from 46% to 37% (from 55 to 44 in 120 possible). But this synchronization increase is even more marked when analyzing mistakes per pair, in which there was a decrease from 60% to 41% (from 36 to 25, in 60 possible). In the slower and faster dances there was a positive influence, while in two dances placed in the middle of the scale (*tango*=120 bpm, *cha-cha-cha*=125 bpm) the number of desynchronized pairs increased from 3 to 4.

DISCUSSION

We can say that the *magnet effect* overlapped the *maintenance tendency*, to use the concepts described by von Holst (1973) and Polemnia *et al.* (1995), which characterize the complexity of interactions. Coordination between the two individuals of the same pair will result from the combination of competition (maintenance of the preferred frequency of each one) and cooperation (attraction to the frequency of the other). In the present study the influence

Table 2. Number of individual and couple mistakes in solo and dance pairs when synchronizing with the metronome.

	Metronome (bpm)	*Solo: Individual mistakes*	*Solo: Mistakes per pair*	*Pairs: Individual mistakes*	*Pairs: Mistakes per pair*
Rumba	95	8	5	6	3
Waltz	100	1	1	0	0
Foxtrot	110	6	4	4	2
Paso doble	115	0	0	0	0
Tango	120	5	3	8	4
Cha-cha-cha	125	5	3	6	4
Samba	135	4	3	1	1
Quickstep	140	11	6	8	4
Viennese waltz	150	9	6	8	5
Jive	155	6	5	3	2

of the pair was mostly positive in the improvement of individual synchronization with an imposed external sound stimulus. But this effect is not linear since in two dances (*tango* and *cha-cha-cha*) a slight increase of errors was verified in the pair situation. Ballroom dances are mainly characterized by men who lead the women. By choosing pairs with at least 3 years of experience we tried to ensure that pairs were familiar and could interact with stability in the execution of the tasks. We found that all the male participants had a SMT above his pair, so to accomplish a task with a considerably fast tempo, the mutual support worked and the cooperation allowed the pair to carry more elements out of their comfort zone to successfully accomplish the required tempo. This cooperation strategy with faster elements looks natural and supports previous studies (Xarez 2011). Another interesting aspect relates to the type of motor tasks performed. In that sense it should be noted the total number of hits found in *paso doble* in both conditions, which may be justified by the rhythmic structure of this dance: it is more marked, binary, and similar to a march. Also, relatively good synchronization was demonstrated in the *slow waltz*, which had only one mistake in the solo situation that was corrected by the presence of the pair. On the other hand, in both the faster and slower dances the role of the pair has shown to be decisive for the reduction of errors and better synchronization to the imposed tempo.

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References

Brown S., Martinez M. J., and Parsons L. M. (2006). The neural basis of human dance. *Cerebral Cortex, 16*, pp. 1157-1167.

Holst E. von (1973). On the nature and order of the central nervous system. In R. Martin (ed.), *The Collected Papers of Erich von Holst*. Coral Gables, Florida, USA: University of Miami Press.

Polemnia G., Amazeen I., Schmidt R. C. *et al.* (1995). Frequency detuning of the phase entrainment dynamics of visually coupled rhythmic movements. *Biological Cybernetics, 72*, pp. 511-518.

Craft R. (1934). *Stravinsky and Robert Craft: Memories and Commentaries*. New York: Doubleday & Company, Inc.

Xarez L. (2011). Dances of Cape Verde: Tempo, preferences and entrainment. In A. Williamon, D. Edwards, and L. Bartel (eds.), *Proceedings of ISPS 2011* (pp. 209-214). Utrecht, The Netherlands: European Association of Conservatoires (AEC).