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Emotional and Neurohumoral Responses to Dancing Tango Argentino: The Effects of Music and Partner

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The present study examines the emotional and hormonal responses to tango dancing and the specific influences of the presence of music and partner on these responses. Twenty-two tango dancers were assessed within four conditions, in which the presence of music and a dance partner while dancing were varied in a 2 × 2 design. Before each condition and 5 minutes thereafter, participants provided salivary samples for analysis of cortisol and testosterone concentrations and completed the Positive and Negative Affect Schedule. The data suggest that motion with a partner to music has more positive effects on emotional state than motion without music or without a partner. Moreover, decreases of cortisol concentrations were found with the presence of music, whereas increases of testosterone levels were associated with the presence of a partner. The authors' work gives evidence of short-term positive psychobiological reactions after tango dancing and contributes to understanding the differential influence of music and partner.

Keywords: dance; music; emotional state; cortisol; testosterone

Musical behaviors and their influence on subjective and biological variables have been long-standing topics of empirical research (Bartlett, 1996). Specifically, psychobiological effects have been investigated in response to music listening (e.g., Gerra et al., 1998) and singing (e.g., Kreutz, Bongard, Rohrmann, Hodapp, & Grebe, 2004). In the present study, we are interested in the influences of music and partner on subjective and neurohumoral parameters in partnered dance.

Dancing is a form of musical behavior that involves the coordination of intentional rhythmical movements to music stimulation. In recent times, there has been growing interest in the investigation of dancing as a potential behavior that actively promotes improvement of people's health. For example, positive psychological changes with respect to stress and anxiety in response to dancing have been shown for healthy individuals (e.g., Lesté & Rust, 1990). In clinical contexts, benefits of dancing have been investigated as a complement in the treatment of mental disorders (e.g., Habousch, Floyd, Caron, LaSota, & Alvarez, 2006) and physical complaints (e.g., Hackney, Kantorovich, & Earhart, 2007).

Thus, there appears to be some initial evidence indicating positive effects of dance activities on emotional state and well-being. However, the specific psychophysiological effects elicited by dancing as well as the influences of key variables mediating these effects are presently unknown. For example, although dance can, in principle, be performed without sound, music appears to be integral to the dance experience. Moreover, many, if not most, forms of dance involve the physical contact and coordination of movement patterns between different individuals. Therefore, it seems likely that the presence of music and partner is essential to the psychophysiological effects of dancing. To address these factors, the present study examines changes in emotional state, cortisol, and testosterone in response to dance under the influence of presence versus absence of music and partner.

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Cortisol is a hormone produced by the adrenal cortex and is involved in responses to physical and emotional stress (Kirschbaum & Hellhammer, 1994). Several studies have demonstrated that stressful events elicit increases in cortisol levels (e.g., Van Eck, Berkhof, Nicolson, & Sulon, 1996), which have been implicated in several illness processes (e.g., Charmandari, Tsigos, & Chrousos, 2005). Likewise, studies indicate an association between positive psychological functioning and lowered cortisol release as a positive indicator of health (e.g., Lindfors & Lundberg, 2002).

There is a growing body of literature, which evidences that music can affect cortisol concentrations. However, it seems that decreases in cortisol levels following listening to music may be moderated by musical style (Möckel et al., 1994). Studies have reported decreases in this hormone after subjects listened to classical or meditative music (e.g., Kreutz et al., 2004), whereas in other studies, increased cortisol levels have been found after listening to fast music (e.g., Gerra et al., 1998). In medical settings, the use of music stimulation has also proven to be effective in improving mood and reducing cortisol concentrations in patients undergoing a variety of clinical interventions, ranging from surgery (e.g., Nilsson, Unosson, & Rawal, 2005) to oncology (e.g., Burns, Harbuz, Hucklebridge, & Bunt, 2001).

Singing, as a form of more active musical behavior, has also been shown to affect cortisol changes. However, specific variables, such as the level of involvement (professional vs. amateur) and the performance situation (rehearsal vs. public concert), appear to influence these changes (e.g., Beck, Cesario, Yousefi, & Enamoto, 1999; Grape, Sandgren, Hansson, Ericson, & Theorell, 2003).

Studies evaluating neuroendocrine responses after dancing are rare. Rohleder, Beulen, Chen, Wolf, and Kirschbaum (2007) examined cortisol changes after competitive ballroom dancing. The authors found that competitive dancing led to elevations of cortisol that were elicited by the social-evaluative performance stressor. In another study, cortisol increases were found after 90 min of an African dance class (West, Otte, Geher, Johnson, & Mohr, 2004). To date, no studies have been found that have addressed the effects of social partnered dancing on cortisol responses.

Testosterone is another hormone that seems to influence important aspects of life. The largest amounts of testosterone are released by the Leydig cells of the testes in men. It is also produced in far smaller quantities in the adrenal cortex and ovaries of females. Primarily functioning as a male sex hormone, testosterone has been implicated in the development of masculine physical characteristics, as well as a spectrum of social behaviors including social dominance (e.g., Mazur & Booth, 1998) and bonding (Roney, Mahler, & Maestripieri, 2003). For example, with respect to associations between testosterone changes and social bonding, significant increases of testosterone have been found in males after short social interactions with women (Roney et al., 2003; Van der Meij, Buunk, Van de Sance, & Salvador, 2008).

Empirical work addressing the effects of music on testosterone appears to be more limited. Fukui (2001) examined the testosterone concentrations in male and female students before and after listening to music. The author observed that testosterone concentrations significantly decreased in males after listening, while concentrations significantly increased in females. At present, there appear to be no studies that have assessed the effects of partnered dance on testosterone in healthy adults.

The purpose of the present study was to analyze the effects of tango dancing on emotional state, cortisol, and testosterone. Specifically, the differential contributions of presence versus absence of music and partner to these parameters were investigated.

Tango argentino is a form of partnered dance that, nowadays, is practiced in many cities worldwide. The most important characteristic of tango argentino is the necessary physical contact between partners and the high levels of sensitivity required to improvise complex combinations of figures and steps in a close embrace. Consistent with previous research, we expected improved emotional state and lower cortisol levels when dancing to music. Furthermore, we expected improved emotional states and increased testosterone concentrations when dancing with a partner. However, the combination of music and partner, as it is realized in regular tango dancing, was assumed to lead to greater positive effects on emotional state, cortisol, and testosterone than when dancing without partner or without music.

Method

Participants

Twenty-two individuals, 11 males and 11 females, with at least 1 year of tango dancing experience, participated in this study after giving written informed consent. Mean age of the participants was 43.09 years (*SD* = 8.03 years), with a range of 30 to 56 years.

Most participants enrolled together with the partner of their choice, with the exception of 4 people (2 females and 2 males), who registered alone and met each other as dance partners at the beginning of this study. All volunteers received a free tango class following each session as compensation for successful participation. The study was carried out in accordance with the Declaration of Helsinki principles.

Materials

The emotional state was measured using the German adaptation of the 20-item Positive and Negative Affect Schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996; Watson, Clarck, & Tellegan, 1988). Cortisol and testosterone concentrations were assessed by using salivary samples.

Research Design and Procedure

This study consisted of four experimental conditions, which were carried out weekly on consecutive Sunday evenings. The tested experimental conditions were (1) regular tango dancing (*with partner and with music*), (2) "dancing" *with partner but without music*, (3) "dancing" *without partner but with music*, and (4) moving *without partner and without music*.

In both conditions of dancing with music, the same pieces of music were used, and in both conditions of dancing with a partner, participants danced with the same partner. To control the effects of the circadian rhythm influences on salivary hormones, data of all experimental sessions were always collected at the same time of day, between 1930 and 2030 hours. In every session, the participants were assigned to one of the four conditions. Each condition lasted 20 minutes. At the beginning and about 5 minutes after the dance condition, participants completed the PANAS inventory and gave the saliva samples. The salivary analysis was conducted at the lab of Prof. Dr. C. Kirschbaum at the Technical University of Dresden. The intra- and interassay coefficients of variance were below 10%, indicating that the degree of accuracy of the lab analysis was satisfactory.

Statistical Analysis

For data analysis, SPSS 12.0 for Windows was used. Because of the anticipation of an unknown situation, the scores measured at the first session, corresponding to the condition of regular tango dancing (with partner and with music), might appear greater in strength. In order to control for this beginning effect, the first condition was repeated in a fifth session at the end of the study. Scores obtained for the first and the fifth session were aggregated, and the resulting means then represented the condition of regular tango dancing (with partner and with music) in further statistical analyses together with the other three conditions.

First, the four conditions were compared for baseline differences using analysis of variance (ANOVA) for repeated measures. Due to the fact that baseline values differed for some of the variables, we conducted subsequent analyses on response values, namely, calculating the differences between pretreatment and posttreatment values.

Afterwards, ANOVAs for repeated measures were conducted based on a 2 (Partner: with partner vs. without partner) $\times$ 2 (Music: with music vs. without music) design. Dependent variables were response values (posttreatment minus pretreatment values) of emotional (positive affect and negative affect) and hormonal measures (cortisol and testosterone). In case significant interaction effects were found, subsequent pairwise comparisons between the four conditions were conducted. In addition, pre- to posttreatment changes were assessed in each condition using pairwise *t*-test comparisons.

Results

Baseline

Comparisons of baselines of dependent variables in the four conditions revealed significant differences in two of the measured variables (see Table 1). For positive affect, the baseline's mean value of the condition of moving without partner and without music was significantly lower than those of both the condition of regular tango dancing (with partner and with music), $t(21) = 2.96$, $p < .01$, and the condition of dancing with partner but without music, $t(21) = 3.23$, $p < .01$. For testosterone, the baseline's mean value in the condition dancing with partner but without music was significantly lower than the baselines of all other conditions: the regular tango dancing (with partner and with music), $t(19) = 2.61$, $p < .05$; dancing without partner but with music, $t(19)$

Table 1. Means (and Standard Deviations) of Baseline Values for Positive and Negative Affect, Salivary Cortisol, and Salivary Testosterone in the Four Conditions

		Condition							
		With Partner and With Music		With Partner and Without Music		Without Partner and With Music		Without Partner and Without Music	
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Positive affect	22	2.50[a]	0.51	2.58[a]	0.48	2.30[a,b]	0.60	2.10[b]	0.68
Negative affect	22	1.30	0.26	1.21	0.19	1.32	0.29	1.19	0.26
Cortisol (nmol/L)	20	3.71	1.32	3.21	2.95	2.98	2.34	2.84	1.42
Testosterone (pg/ml)	20	21.40[a]	13.18	18.27[b]	10.79	22.31[a]	13.17	24.43[a]	16.85

Means in the row that do not share subscripts differ at $p < .05$.

= 2.79, $p < .05$; and moving without partner and without music, $t(19) = 2.76$, $p < .05$.

Positive and Negative Affect

The ANOVA for positive affect indicated a significant interaction between Partner and Music, $F(1, 21) = 5.06$, $p < .05$, partial $\eta^2 = .19$. Post hoc analysis revealed significant differences in the positive affect changes between the regular tango dancing (with partner and with music) condition and the other three conditions: $t(21) = 2.31$, $p < .05$; $t(21) = 4.38$, $p < .001$; $t(21) = 2.63$, $p < .05$, respectively. Furthermore, direct comparisons of pretreatment and posttreatment values by means of paired t tests indicated a significant increase in positive affect scores only for the condition of regular tango dancing (with partner and with music) ($M = 0.68$, $SD = 0.37$), $t(21) = 8.57$, $p < .001$, but not for the other three conditions, all $p > .05$ (see Figure 1).

With regard to the ANOVA for the negative affect scores, neither a significant effect nor an interaction between Partner and Music was found. Pairwise comparisons of baseline and posttreatment values showed a significant decrease of negative affect only after the conditions of regular tango dancing (with partner and with music) ($M = –0.15$, $SD = 0.26$), $t(21) = 2.73$, $p < .05$, and moving without partner and without music ($M = –0.10$, $SD = 0.19$), $t(21) = 2.40$, $p < .05$ (see Figure 1).

Cortisol

The ANOVA for the cortisol concentrations indicated a significant main effect for Music, $F(1, 19) = 5.45$, $p < .05$, partial $\eta^2 = .22$, and an interaction

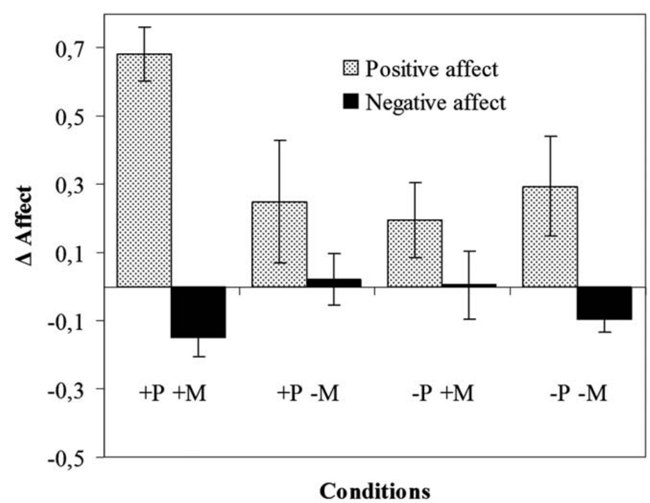

Figure 1. Positive and negative affect changes during the four experimental dance conditions. +P +M = with partner with music; +P −M = with partner without music; −P +M = without partner with music; −P −M = without partner without music.

effect between Partner and Music, $F(1, 19) = 4.11$, $p < .05$, partial $\eta^2 = .18$. The main effect of music suggests that there were stronger decreases of cortisol in the music than in the no-music conditions ($M = –0.62$ nmol/L, $SD = 0.60$; and $M = –0.30$ nmol/L, SD = 0.61, respectively). Post hoc analyses revealed a significant difference between the conditions of regular tango dancing (with partner with music) ($M = –0.80$ nmol/L, $SD = 0.82$) and dancing with partner but without music ($M = –0.29$ nmol/L, $SD = 0.88$), $t(19) = 3.11$, $p = .006$. Pairwise comparisons of baseline and posttreatment values show that cortisol decreased in all conditions, except when dancing with partner but without music, with the strongest reduction of cortisol in the

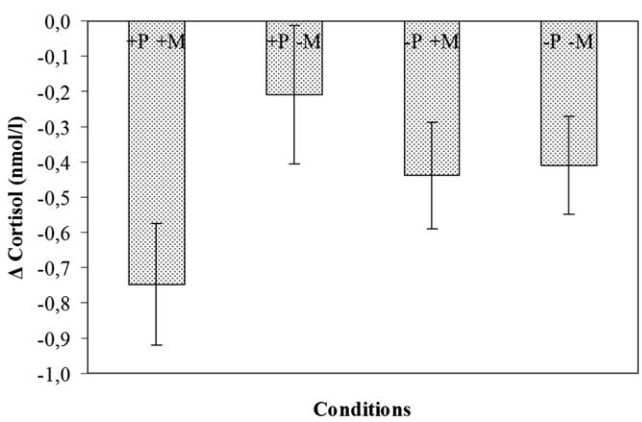

Figure 2. Salivary cortisol changes during the four experimental dance conditions. +P +M = with partner with music; +P −M = with partner without music; −P +M = without partner with music; −P −M = without partner without music.

condition of the regular tango dancing (with partner with music), $t(19) = 4.33$, $p < .001$. Figure 2 shows the changes in cortisol concentrations for each condition.

Testosterone

The ANOVA for the testosterone changes showed a significant main effect of Partner, $F(1, 19) = 4.55$, $p < .05$, partial $\eta^2 = .19$, and a significant interaction between Partner and Music, $F(1, 19) = 4.38$, $p < .05$, partial $\eta^2 = .19$. The main effect of Partner suggests that increases of testosterone levels were significantly higher in the partner than in the no-partner conditions ($M = 2.66$ pg/ml, $SD = 4.45$; and $M = –0.260$ pg/ml, $SD = 4.23$, respectively).

Post hoc analyses showed a significant difference between the conditions of dancing with partner but without music ($M = 4.15$ pg/ml, $SD = 5.88$) and moving without partner and without music ($M = –1.45$ pg/ml, $SD = 6.95$), $p < .05$.

However, unlike the other dependent variables, the course of testosterone concentrations was different between Sessions 1 and 5, when the condition of regular tango dancing (with partner and with music) was implemented. In the first session, a significant increase of testosterone was shown ($M = 4.06$ pg/ml, $SD = 5.77$), $t(19) = 3.15$, $p < .01$, while in the fifth session, by contrast, no change was found ($M = –1.76$ pg/ml, $SD = 7.19$), $t(19) = 1.10$, $p = .29$, which suggests an influence of order of session. ANOVA with only the testosterone changes of the first session for the condition of dancing with partner and with music evidenced a significant main effect of Partner, $F(1, 19) = 10.19$, $p < .01$, partial $\eta^2 = .35$. Furthermore, the same significant increase of testosterone after both the condition of dancing with partner and with music (Session 1) and the condition of dancing with partner but without music was found, $t(19) = 3.15$, $p < .01$. Table 2 displays the means and standard deviations of testosterone values before and after each session as well as the calculated differences (posttreatment minus pretreatment values). Males and females differ in the amount of testosterone concentrations, although no gender differences concerning the course of hormonal change were found in any of the conditions.

Discussion

The present study examined the emotional and hormonal effects of a particular form of partnered dance, tango argentino. Specifically, changes of emotional state and hormonal markers, namely, cortisol and testosterone, were investigated across four conditions that included dancing in the presence versus in the absence of a partner and music.

We found evidence that the regular tango dancing (with partner and with music) led to significant increases of positive affect and to reductions of negative affect. These results corroborate previous work, which showed improvements of self-reported emotional state and well-being in response to dancing in studies addressing a range of social groups and dance styles (e.g., Lesté & Rust, 1990; West et al., 2004).

Concerning the first of our two biological measures, we observed that regular tango dancing (with partner and with music) led to significant decreases in salivary cortisol concentrations. This effect was further influenced by the music stimulation but not by the presence of a dance partner. Previous work has shown that music listening can have a decreasing effect on cortisol levels (e.g., Kreutz et al., 2004; Möckel et al., 1994). Our data suggest that this effect extends to a more active musical behavior.

It is worth noting that usually cortisol decreases during the course of the day as part of its circadian rhythm. However, the circadian rhythm of cortisol cannot serve as an explanation for the effects found in the present study, because the saliva samples were always taken at the same time of the day for all

Table 2. Means (and Standard Deviations) of Salivary Testosterone Values Before and After Each Condition and Differences Between Pretreatment and Posttreatment Values

	Testosterone (pg/ml)					
	Pretreatment		Posttreatment		Differences	
Dance Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*
With partner and with music	21.40	14.18	22.55	14.51	1.15	5.85
Males	33.55	8.16	35.10	11.46		
Females	11.46	5.96	12.28	6.08		
Session 1	20.73	2.76	24.78	3.45	4.06[a]	5.77
Males	30.90	9.69	36.26	14.23		
Females	12.40	6.79	15.40	8.72		
Session 5	22.07	15.14	20.31	14.39	–1.17	7.19
Males	36.20	9.67	33.94	9.58		
Females	10.52	5.89	9.15	3.96		
With partner and without music	18.27	2.41	22.41	2.94	4.15[a]	5.88
Males	27.96	6.71	32.77	10.57		
Females	10.34	5.62	13.94	7.99		
Without partner and with music	22.31	2.94	23.23	3.29	0.92	4.16
Males	33.19	10.65	35.60	11.32		
Females	13.41	6.70	13.11	7.72		
Without partner and without music	24.43	3.77	22.99	3.9	–1.45	6.96
Males	37.52	15.87	36.71	17.50		
Females	13.73	7.60	11.77	4.85		

[a] Testosterone concentrations after both the condition of dancing with partner and with music (Session 1) and the condition of dancing with partner but without music were significantly higher than the baselines values, $t(19) = 3.15$, $p < .01$.

conditions, and we found the decreases to be significantly different between the conditions.

Our results contrast with the findings of West et al. (2004), who observed significant increases rather than decreases of cortisol in dancers of African rhythms over a 90-min period. The African dancing seems to be a more vigorous activity that, therefore, could have involved greater physical effort than was the case in our tango dance classes. It has been shown that a physical activity leads to increases in cortisol levels, if it exceeds certain thresholds. For instance, when exercising with 55% of maximal oxygen uptake (VO_{2max}), an exercise duration beyond 80 min is sufficient to activate the hypothalamic-pituitary-adrenal axis (Tremblay, Copeland, & Van Helder, 2005). On the other hand, tango dancing appears to be a moderate activity. According to Peidro et al. (2002), the VO_2 during tango dancing is between 46% and 55% of VO_{2max}. Thus, the physical strain required by tango dancing during 20 min is probably not sufficient to elicit increases in cortisol levels.

The results in this study also differ from the findings of Rohleder et al. (2007). The authors examined the cortisol changes in ballroom dancers in a competitive situation and found increases of cortisol levels. These increases were furthermore explained not by the physical strain but by the psychological stress of the social evaluative threat situation. In contrast, the present study was not designed to evaluate dancing as a competition but rather the social leisure dance activity. Therefore, participants in our study most likely learn to dance predominantly for pleasure and enjoyment.

Finally, significant effects of partnered dance on testosterone changes were observed, but no gender effects were found to influence these changes. In traditional tango, gender roles appear to be strongly differentiated in that the man leads and suggests the direction, form, and tempo of the figures, while the woman interprets and follows his movement impulses. However, it should be noted that in present times, the traditionally passive role of the "dominated" woman is being changed into a more active role, following a more balanced interplay within the couple. This fact might reflect the similar testosterone responses in both males and females. On the other hand, the differential effects that Fukui (2001) found in males and females after passive listening to music (testosterone increase in women, decrease in males) do not seem to occur when music is accompanied by body movement.

We found partial confirmation of our working hypothesis that partnered dance leads to increases of testosterone. This hypothesis was based on the idea that the exposure to the physical proximity of the partners elicits testosterone increases (Roney et al., 2003). In particular, we found the expected increase of testosterone concentrations when dancing in couples within the first and the second sessions only, but there was no increase when the first condition was repeated in the fifth session. The fact that the fifth session was also the last and was thus associated with the prospect of the end of the study and the free tango lessons, might have had the potential to moderate the reactive testosterone increases elicited when dancing with the partner. Until now, no studies have addressed the possible confounding influence of social environment changes on this hormone, such as the implications of a last session after repeated measures, as was the case in our study. The impact of the presence of a partner on testosterone concentrations, when measured after several repeated occasions, remains also to be explored in further studies.

Due to the small number of subjects, these results should be interpreted with some caution. Replications of our findings with tango dancers with different demographic and cultural background, as well as with samples representing other dancing styles, using similar methods as this study, are mandatory. Variables relating to the nature of the dance—couple or solo dance, (un)familiarity between partners, movement intensity, musical features, and length of the activity—need to be considered in future research.

In summary, we found that tango dancing can be seen as an antistress behavior capable of producing short-term positive psychophysiological changes. Moreover, our results show that both the presence of music and the physical contact with a partner differentially influence the related emotional and hormonal responses to dancing. In particular, it was shown that decreases in cortisol were more strongly related to music stimulation, while increases in testosterone were, in part, related to the presence of a partner. These results suggest that our psychophysiological approach appears efficient in addressing significant areas of mental and physical well-being and health in relation to dance. More psychophysiological approaches are needed to establish a firm empirical basis for those intervention programs that use dancing for promoting health and well-being.

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Declaration of Conflicting Interests

The authors have declared that there are no conflicts of interests in the authorship and publication of this contribution.

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