

Evaluating the Performance of Adjudicators after a DanceSport Competition

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Abstract

Cognitive and emotional ability are relevant during sport assessments and decision-making. This study explored the impact of vigilance, perceived effort, and mood state of DanceSport adjudicators during a High Level Competition. Thereby, seven international adjudicators completed Borg's Rate of Perceived Exertion (RPE) Scale, BRUMS questionnaire, and Attentional Task (Psychomotor Vigilance Task - PVT) before and after a dance competition. The results indicated differences in RPEs ($p = .05$) with a high RPE after competition (pre competition $M = 9.14$, $SD = 2.67$ and post competition $M = 13.71$, $SD = 3.30$). Furthermore, their mood tension and vigor, resulted negatively affected after competition. Moreover, younger adjudicators produced more anticipations than older ones to the reaction to external stimuli. In conclusion, DanceSport competitions entail physical, emotional, and cognitive changes that could affect the quality of decisions while judging.

Keywords: DanceSport; Adjudicators; Attention; Vigilance; Mood State

The figure of sport judges is essential for the competition but, despite their relevance, they have not received sufficient attention from researchers (Hancock, Rix-Lièvre and Côté, 2015; Mascarenhas, Collins and Mortimer, 2005) particularly in DanceSport.

DanceSport is the competitive form of ballroom dancing (McCabe, Wyon, Ambegaonkar and Redding, 2013) where mixed couples perform their choreographies simultaneously to overcome several elimination rounds of five dances (per modality) of 90 to 120 seconds each. Judges (*adjudicators* in DanceSport) select the best dance couple of each round until there are only six of them left, who compete in the final round. The minimum number of adjudicators that have to be present during an official competition is seven at higher levels (A-International, A-National and B-National) and five at lower levels (C-National, 1st territorial, 2nd territorial and F- Pre-competition) (Federación Española de Baile Deportivo, 2012).

The evaluation of the dance couples takes place in a wide space and in a limited time (Tremayne and Ballinger, 2008), demanding a fast detection of relevant stimuli while avoiding irrelevant stimuli or distractions (Weinberg and Richardson, 1990). Moreover, DanceSport competitions last between 6 and 8 hours. During this time, adjudicators have to be standing up, what can cause both physical and mental fatigue.

Adjudicators can optimize their performance by improving emotional or cognitive skills (Janelle and Hillman, 2003), being the decision-making process the most relevant aspect of umpiring (Helsen and Bultynck, 2004), which can be affected by attention (Orquin and Mueller, 2013). Attention plays a major role in human behaviour (Petersen and Posner, 2012), and has been proposed as the key mechanism in selection of relevant information and responsible of cognitive resource assignment. Especially in umpiring, attention allows to select the most relevant information of the competition (Pietraszewski et al., 2014).

However this process can be impaired in high demanding physical or mental tasks (Boksem, Meijman and Lorist, 2005), like in sport competition, where distractors (e.g. noise, music) compete with relevant stimuli, causing a reduction of cognitive resources allocated to a concrete task (Moran, 1996).

According to Posner's (2008) theory of attentional networks, the ability to generate and sustain a state of alert for expected stimuli is controlled by the vigilance network. Vigilance is the voluntarily sustained predisposition to respond during a concrete task (Roca, Castro, López-Ramón and Lupiáñez, 2011). Reduction in vigilance is known as «vigilant decrement», which has been explained by the reduction of arousal and the depletion of cognitive resources over time (Parasuraman and Davies, 1984). Under high physiological

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arousal, the attentional focus tends to be narrower than under conditions of low arousal (Easterbrook, 1959). The ability of adjudicators to maintain a high level of arousal during competition is of great relevance. Competitive sport is replete with a variety of distractions that can disrupt athletes' concentration. These distractions are divided into: external and internal. Being the external objective stimuli that deviate the attentional focus away from its objective. While the interns include a wide range of thoughts, feelings and body sensations prevent athletes from concentrating (Moran, 1996).

Additionally, adjudicators have to judge after several hours of physical activity (walking and standing up). However, acute physical activity can improve cognitive performance (Chang, Labban, Gapin and Etnier, 2012; see meta-analysis of Lambourne and Tomporowski, 2010). Several researchers (Cotman and Berchtold, 2002; Ide and Secher, 2000; Pesce, Tessitore, Casella, Pirritano and Capranica, 2007) have proposed that physical activity-induced increments in arousal, enhance the amount of cognitive available resources which consequently improve performance in cognitive tasks. Therefore, physical activity during umpiring could modify adjudicators' arousal and vigilance. Research about the alerting network, proposed by Posner (2008), after exercise or physical activity is somewhat limited. Researchers have found a reduction in vigilance after a mental effort while it was increased after physical effort (Smit, Eling, Hopman and Coenen, 2005). Similarly, Huer-tas, Zahonero, Sanabria and Lupiáñez (2011) proved that aerobic physical exercise reduces reaction time (RT) of phasic alert (activation or temporal state of alert caused by an external stimulus) and, recently, Chang, Pesce, Chiang, Kuo and Fong (2015) observed larger P3 amplitude in the alerting network task after an exercise bout.

As far as we know, there isn't any scientific work that has focused on the study of the impact of umpiring (and its mental and physical characteristics) on vigilance of adjudicators during DanceSport competitions. However, a better understanding of the attentional response of DanceSport adjudicators during their professional activity is critical to propose new improving strategies, specific training and optimizing sport umpiring.

Besides, emotional state has a direct impact on the assessment of the adjudicators and might also affect the outcomes of a competition (Butler, 1996; Perederij, 2013). Also, some emotions can lead to increases and decreases of arousal levels (e.g., anxiety, excitement, disappointment, sadness) while others have little or no impact (e.g., guilt; Zillmann, Katcher and Milavsky, 1972).

In summary, the present study has two main aims. Firstly, we evaluate attentional abilities and emotional state of DanceSport adjudicators. Secondly, we investigate the impact of attentional fatigue and rate of perceived effort (RPE) of the DanceSport adjudicators before and after a high level DanceSport competition.

Method

Participants

In this study, seven international Spanish adjudicators (four men and three women, 44.57 ± 12.78 years; 3 adjudicators > 35 y/o and 4 < 35 y/o) with 3 to 13 years of experience DanceSport umpiring (6.71 ± 4.42 years of experience). Two groups *older* (> 35 y/o; 3 adjudicators) and *younger* (< 35 y/o; 4 adjudicators).

Instruments and Procedures

Recruitment was done through the Spanish Federation of DanceSport. We contacted the adjudicators selected to judge a national competition celebrated in Spain. They were informed prior to the competition about the purpose of the study. Adjudicators volunteered to participate. The study protocols and procedures were approved by the Ethics Committee of the University of Lausanne and meet the requirements of Helsinki Declaration of 1964.

Adjudicators arrived at the installations one hour before the event (9 am). They read and signed the consent form (Federación Española de Baile Deportivo, 2012). Next, adjudicators completed the Brunel Mood Scale Questionnaire (BRUMS; Terry, Lane and Fogarty, 2003; Terry, Lane, Lane and Keohane, 1999), the Psychomotor Vigilance Task (PVT; Correa, Molina and Sanabria, 2014; Lara, Madrid and Correa, 2014) and a self-reported personal questionnaire about their experience on umpiring and their years of experience. Once the competition finished (by 7.00 pm) adjudicators filled in for the second time the BRUMS and the PVT, and they were also requested to complete Borg's Rate of Perceived Exertion Scale (Borg, 1982).

Attentional Task

We used the PVT designed by Correa et al. (2014). The PVT provides a measure of the overall level of vigilance of the adjudicators (Dinges and Powell, 1985). Each trial starts with a black circle with a red edge presented at the center of the screen for a random interval (2-10 seconds). Adjudicators had to detect as fast as possible (while avoiding anticipations) when the circle started to fill up, and then press the space bar to indicate it. This action stopped the progress of the circles and RTs were recorded, considering 200-300 ms and 900-1000 ms as very fast or very low RTs respectively (range 200-1000 ms). Following Chang et al. (2015), anticipations were considered as any reaction time faster than 200 ms. The task lasted 5 minutes. All adjudicators performed the task individually using a laptop PC running the E-Prime software (Schneider, Eschman and Zucolotto, 2002) that controlled the presentation of stimuli, timing operation, and collection of responses.

Mood Evaluation

The Spanish version of the BRUMS (Cañadas, Monleón, Sanchis, Fargueta and Blasco, 2017) was used. BRUMS questionnaire (Terry et al., 1999, 2003) is a derived scale from the Profile of Mood States (McNair, Lorr and Droppleman, 1971). It is composed by 24 items, grouped in six dimensions that indicate different moods: anger, confusion, depression, fatigue, tension and vigor. Adjudicators indicated to what extent they were experiencing the feeling at that moment, in a scale from 1 (*not at all*) to 5 (*very much*).

Perceived Exertion

The Borg Scale (Borg, 1982) was used pre and post competition to measure physical sensations which the adjudicator experienced before and after the performance of judging, such as increased heart rate, increased respiration, increased sweating, and muscle fatigue. Scores in this questionnaire range from 6 *no exertion at all* to 20 *maximal exertion*. Ratings between 12 and 14 on this scale suggest that the activity was hard (Noble and Robertson, 1996).

Design and Data Analysis

The Shapiro-Wilk test was applied to analyze normality. Thereby, the values in the study were obtained by using the paired Student's *t*-test, with a 95% confidence interval ($p < .05$) or with the Wilcoxon test when the distribution of normality was not verified.

Given the reduced number of participants, we conducted a reliability test of the BRUMS. Following Terry et al. (2003), some items were not reliable and therefore eliminated from final analyses (see Table 1). Once those items were eliminated, the reliability of the questionnaire was appropriated, especially Dimensions 1, 3, 4 and 6. However, Dimensions 2 and 5 were not totally reliable most probably due to the reduced simple size (Table 1). Those dimensions were not included in future analysis.

Table 1
Cronbach's Alpha for Each Dimension Upon Removal of the Items

Dimension		Item removed		Cronbach's Alpha ^a
Nº	Name	Nº	Name	
1	Anger	11	Bitter	.94
2	Confusion	-	-	1.55E-16
3	Depression	12	Unhappy	.77
4	Fatigue	21	Tired	.94
5	Tension	1	Panicky	.27
6	Vigour	2	Lively	.93

Note: ^aViera and Garrett (2005), Cronbach alpha < 0 no agreement; between .01 and .20 slightly agreement; between .21 and .40, fair

agreement; between .41 and .60, moderated agreement; between .61 y .80, considerable agreement, between .81 and .99 almost perfect agreement.

After the normality test (Table 2), data were divided by time of competition (pre and post) for the four dimensions that were reliable (Table 3).

Table 2
Normality Test

Dimension	Measurement moment	Shapiro-Wilk test		
		Statistical	gl	Sig.
Anger	Post	.453	7	.00
Depres- sion	Pre	.600	7	.00
	Post	.717	7	.01
Fatigue	Pre	.710	7	.01
	Post	.930	7	.55
Vigour	Pre	.961	7	.83
	Post	.987	7	.99

We performed a normality test on data coming from BRUMS, following Shapiro-Wilk for each dimension in each time of competition (pre and post). Finally, those data were analyzed by performing paired comparisons Student's *t*-test. Then we created a new variable for each dimension, by obtaining a differential score between post and pre competition, to evaluate changes in mood due to competition. Dimension 1 pre competition (anger) was dismissed to appear as a constant variable, as all adjudicators rated similarly. Only dimension 6 (vigor) followed distribution of normality (scored higher to .05) pre and post competition. Dimensions not respecting normality were susceptible of non-parametric analysis (Wilcoxon) while dimension 6 was analyzed by means of Student's *t*-test. According to Terry et al. (2003), a final index of Total Mood Disturbance (TMD) was calculated to evaluate general mood of adjudicators after competition, $TMD = (M_{tension} + M_{depression} + M_{anger} + M_{fatigue} + M_{confusion}) - M_{vigor}$. This index has been frequently used in sport contexts (e.g., Berger and Motl, 2000; Woods et al., 2014). Following Rueda and Castro (2010), age could be a moderating factor while performing divided attentional tasks. We consequently divided the sample in two groups *older* (> 35 y/o; 3 adjudicators) and *younger* (< 35 y/o; 3 adjudicators; Rueda and Castro, 2010) ANOVAs were performed, taking into account age as a factor for the PVT.

Results

Attentional task analysis

RT. Paired Student's *t*-test before and after competition showed no significant differences between adjudicators PVT median RT, $t(6) = 1.36, p = .22$. We performed the same analyses but taking in account age of the adjudicators. Paired Student's *t*-test showed no significant differences during PVT task conducted by young adjudicators (≤ 35 years old) before and after dance competition between median RT, $t(2) = -.99, p = .43$. However, when only older adjudicators were taken into account (>35 y/o), paired Student's *t*-test showed a significant difference between PRE (Median = 375.25, $SD = 16.58$) and POST (Median = 329.5, $SD = 31.691$) median RT, $t(3) = 3.18, p = .05, d = 1.10$.

Lapses. No significant differences were found in number of lapses during PVT before and after dance competition when Wilcoxon test was performed ($Z = -.60, p = .55$), even when the analysis was conducted separately in older [$t(2) = .42, p = .70$] and younger [$t(2) = .33, p = .77$] adjudicators by Paired Student's *t*-test.

Anticipations. Likewise, we found no significant differences in number of anticipations during PVT before and after dance competition when Wilcoxon test was performed ($Z = -1.89, p = .06$), even when analysis was conducted separately in older ($Z = -1.41, p = .16$) and young ($Z = -1.34, p = .18$) adjudicators. However, the ANOVA on number of anticipations before dance competition showed a significant effect of age group, $F(1, 6) = 7.00, p = .05$, that was confirmed with an Unpaired Student's *t*-test: there was a significant difference in number of anticipations before competition of young adjudicators ($M = 1.67; SD = .577$) and old adjudicators ($M = .50; SD = .577$); $t(5) = 2.646, p = .046$, with more anticipations committed by the group of young adjudicators. Similarly, ANOVA also showed a marginal effect of group age on number of anticipations after competition: $F(1,6) = 5.71, p = .06$. Unpaired Student's *t*-test showed marginal differences on number of anticipations after competition between young ($M = .67; SD = .577$) and old adjudicators ($M = .00; SD = .000$) [$t(5) = 2.390, p = .062$]. These data suggest a trend to make more anticipations by younger adjudicators after several hours of umpiring.

Mood Evaluation

Differentials analysis between pre and post competition in the different dimensions of BRUMS questionnaire showed significant differences in the dimensions of fatigue ($p = .03$) and Vigor ($p = .04$; Table 3). Finally, we can see that the index of Total mood disturbance was significant ($p = .01$).

Table 3

Descriptive statistics

Dimension	Measurement moment	N	Mean	SD	<i>p</i> -value ^a
Anger	Pre	7	.00	.00	.32
	Post	7	.19	.50	
Depres- sion	Pre	7	.09	.16	.16
	Post	7	.33	.47	
Fatigue	Pre	7	.33	.47	.03
	Post	7	1.52	1.00	
Vigour	Pre	7	2.57	.83	.04
	Post	7	1.52	1.03	
TMD	Pre	7	-2.14	1.25	.01
	Post	7	.52	2.26	

Note: ^a *t*-test performed comparing pre and post evaluations.

Borg's Perceived Exertion

Borg's Scale showed a significant difference between pre ($M = 9.14, SD = 2.67$) and post ($M = 13.71, SD = 3.30$) competition, $t(6) = -.241; p = .05$.

Discussion

The main aim of our study was to evaluate emotional state and cognitive capabilities on adjudicators before and after a DanceSport competition. A secondary aim was to report the effect of fatigue and RPE on adjudicators.

Adjudicators reported high RPE after the competition (Jakobsen, Sundstrup, Persson, Andersen and Andersen, 2014), a predictor of fatigue or muscle load, equivalent to a «moderate intensity» and 85% HR_{max} in aerobic exercises (Zeni, Hoffman and Clifford, 1996). This high effort perception is probably due to the long and hard umpiring session. The RPE reported by adjudicators highlights the great effort made during the competition.

Besides, adjudicators' mood changed significantly after the competition with an increase in the fatigue dimension, a reduction of vigor and a general change in mood state reflected by the TMD-index. Finally, the PVT showed a significant shorter RT in older adjudicators (>35 y/o) after dance competition.

Vigilance, has shown to drop-off in performance as time on task increases (Lara et al., 2014; Mackworth, 1948). However, literature has also shown how different tasks can affect vigilance differently (Smit et al., 2005), being improved after a moderate physical effort and impaired after an extenuating mental effort. Huertas et al. (2011) argued that due to the physiological state of readiness created after an acute physical effort, alerting network and RT speed are

improved. Thus, RT reduction observed after dance competition in older adjudicators could be due to the higher arousal induced by moderate physical effort during umpiring.

Although, as far as we know, this is the first study to report specific vigilance data of DanceSport adjudicators after competition, our results are in accordance with previous research (Chang et al., 2015; Huertas et al., 2011; Smit et al., 2005) with similar physical intensity, showing a reduction of RT after competition as a signal of improving in vigilance function. Smit et al. (2005), showed how a physical effort (*moderately strenuous* cycling effort, equivalent to 5.4 points of 10 possible in Borg modified Scale) increases vigilance on a subsequent mental task. Also, Huertas et al. (2011) found that vigilance increases during acute moderate (80% of lactate threshold) physical effort by an improve of phasic alertness and, finally, Chang et al. (2015) report an increase on P3 amplitude (measured by EEG) after a 75-85% HR_{max} physical effort on cycle-ergometer. However, differences in task, sample and intensity/perceived effort (Chang et al., 2015; Huertas et al., 2011; Smit et al., 2005) do not allow us to make direct comparisons. Furthermore, we only observed a significant reduction in RT of older adjudicators, not observed in younger adjudicators (despite a non-significant reduction in RT after competition) probably caused by the small sample size, and might be due to the experience of the adjudicators.

These results contribute to current knowledge of vigilance response after sport specific activities by showing, in this particular context, a reduction of RT in older adjudicators. It could be argue that this facilitation effect on RT could be due to low intensity demands of umpiring, which was not exigent enough to impair vigilance, as it has been shown before (Mahoney, Hirsch, Hasselquist, Leshner and Lieberman, 2007), but can increase arousal level. Our results also support Huertas et al. (2011) hypothesis about an improvement in RT after a moderate intensity physical effort, thanks to an exercise-induced increment in tonic alertness and besides the increase in BRUMS fatigue dimension. RT is essential in DanceSport judging, where visual and rapid discrimination of important stimuli from all the dance couples determines the final punctuation.

Additionally, our data showed that younger adjudicators are significantly more susceptible to commit response anticipations before competition. We think that this result, could be due to an excessive activation of younger adjudicators before their duty, and could lead to errors or bias while judging. Moreover, after competition, a non-significant trend in the same direction was observed (younger adjudicators trends to commit more anticipations). In this sense, we think that expertise allows adjudicators to manage arousal to optimal levels during umpiring and maybe affect RTs, but our design doesn't allow us to make any

solid conclusion about this. However, there are reports of expertise differences in attentional functioning (fixation time and error detecting) between rhythmic gymnastics judges (Flessas and Mylonas, 2015) and extended research has been made about expertise and discrimination capacity (Cereatti, Casella, Manganelli and Pesce, 2009; Pesce et al., 2007), or orienting of attention (Memmert, 2009).

Fatigue seems to impact greatly on the task of umpiring, at both physical and mental levels, due to the long and hard going session of umpiring (Perederij, 2013). In line with Perederij (2013), data from BRUMS confirmed a significant increase in psychological fatigue (difference pre/post competition) that can affect memory negatively and produce a decrease of attention, which can lead to important errors in the umpiring process. However, RT post-competition is faster than RT pre-competition despite psychological fatigue in older adjudicators. This contradiction may be due to an increase in arousal or activation caused by physical activity during umpiring.

Given the speed of actions and simultaneous execution during DanceSport competition (Tremayne and Ballinger, 2008), we believe that slower RTs to certain stimuli (e.g., technical mistakes or body posture) could lead to stressful situations and affect quality of umpiring, but this hypothesis must be verified in future research.

Although a larger sample would have yielded more information, it is important to remark that the recruited sample conforms 100% of the referees who can judge a competition (seven adjudicators). We believe that comparing different adjudicators in different competition setting could be also problematic given that duration, external factors, and individual differences can play and important part in comparing results with the data reported here. Among these factors, we can highlight the caffeine intake, the hours of sleep and the years of experience of the adjudicators. Further studies should investigate the effect of several days of competitions in adjudicators physical, emotional, and attentional capacities and also, compare adjudicators in different levels of competition.

Despite the importance of the results and the ecological design of our study, we are aware of the possible influence of extraneous variables before the competition (e.g. food, sleep, and exercise) and even environmental variables (noise and temperature). For this reason, future studies in this field must increase the sample and control external agents, in order to prevent loss of vigilance by the adjudicators.

In summary, a day of DanceSport umpiring brings about changes at cognitive, physical and emotional levels that could be affecting the quality of the decisions made during the competition. Further works could be devoted to the training of those capabilities and to arrange schedule competition programs, which take into account the health of the adjudicators.

Evaluación el rendimiento de los jueces después de una competición de baile deportivo

Resumen

Las habilidades cognitivas y emocionales son relevantes durante el arbitraje deportivo. Este estudio analizó el impacto de la vigilancia, percepción del esfuerzo, y el estado de ánimo de los jueces de Baile Deportivo durante una competición de alto nivel. Así, siete jueces internacionales completaron la escala de esfuerzo percibido de Borg (RPE), cuestionario BRUMS y la tarea atencional PVT (Tarea de vigilancia psicomotora) antes y después de una competición de baile. Los resultados indicaron diferencias en RPE ($p = .05$) con un elevado RPE tras competición (pre competición $M = 9.14$, $SD = 2.67$ y post competición $M = 13.71$, $SD = 3.30$). Por otra parte, su estado anímico de tensión y vigor, resultó afectado negativamente después de la competición. Además, los jueces más jóvenes producen más anticipaciones que los más mayores ante estímulos externos. En conclusión, las competiciones de Baile Deportivo conllevan cambios físicos, emocionales y cognitivos que podrían afectar a la calidad de las decisiones mientras se está juzgando.

Palabras clave: Baile Deportivo; Jueces; Atención; Vigilancia; Estado de ánimo

Avaliação do desempenho dos juízes após um concurso de dança de desportiva

Resumo

As competências cognitivas e emocionais são relevantes durante a arbitragem desportiva. Este estudo analisou o impacto da vigilância, a perceção do esforço e o humor dos juizes de Baile Desportivo durante uma competição de alto nível. Assim, sete juizes internacionais completaram a escala de esforço percebido de Borg (RPE), o questionário BRUMS e a tarefa atencional PVT (Tarefa de vigilância psicomotora) antes e depois de uma competição de dança. Os resultados indicaram diferenças na RPE ($p = 0.05$) com valores elevados de RPE após competição (pré-competição $M = 9.14$, $SD = 2.67$ e pós-competição $M = 13.71$, $DP = 3.30$). Por outro lado, os seus estados de tensão e vigor foram afetados negativamente após a competição. Adicionalmente, os juizes mais jovens produzem mais antecipações do que os mais experientes face a estímulos externos. Em conclusão, as competições de dança desportiva implicam mudanças físicas, emocionais e cognitivas que podem afetar a qualidade das decisões enquanto se está a ajuizar.

Palavras-Chave: Baile Desportivo; Juizes; Atenção; Vigilância; Estado de humor.

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