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# How do Para swimmers respond physiologically and cognitively when watching their performance at the Paralympic Games? A Case Study

# ¿Cómo los nadadores paralímpicos responden fisiológicamente y cognitivamente cuando ven seu desempenho nos Jogos Paralímpicos? Um estudio de caso

# Como nadadores paralímpicos respondem fisiologicamente e cognitivamente ao assistirem seu desempenho nos Jogos Paralímpicos? Um estudo de caso

Bardella Soares, Bruna[1,2], Winckler, Ciro1

[1] *Universidade Federal de São Paulo. Santos: Brasil*

*2 Comitê Paralímpico Brasileiro, São Paulo Brasil*

## RESUMEN

El objetivo de esta investigación fue analizar la respuesta de activación cognitiva y fisiológica de nadadores paralímpicos (n= 12) al ver la grabación de su prueba en los Juegos Paralímpicos. El diseño metodológico del estudio fue transversal y se llevó a cabo en dos etapas. El video contenía tres momentos: línea de base (LB), video neutral (VN) y video de los Juegos Paralímpicos (VJUEGOS). Durante las pruebas, se analizaron la variabilidad de la frecuencia cardíaca (VFC) y la actividad electrodérmica (EDA) para evaluar la activación fisiológica. También se recolectaron datos de activación cognitiva (Inventario de Ansiedad Estado). Se observó una reducción significativa en el tiempo medio de ritmo cardiaco y un aumento en los datos de conductancia con relación a VNxVJOGOS. No hubo diferencias significativas en las activaciones cognitivas. Si bien se puede explorar el uso de videos, debe tenerse en cuenta que el contenido puede causar respuestas positivas o negativas al rendimiento.

**Palabras clave:** Atleta Paralímpico; Ansiedad; Activación; Rendimiento.

## ABSTRACT

The aim of this study was to analyse the cognitive and physiological activation response of Paralympic swimmers (n= 12) when watching the recording of their events at the Paralympic Games. The methodological design of the study was cross-sectional and carried out in two stages. The video contained three moments: baseline (BL), neutral video (NV) and Paralympic Games video (GAMESV). During the tests, Heart Rate Variability (HRV) and Electrodermal Activity (EDA) were analysed as a way to evaluate physiological activation. Before and after the video, cognitive activation data (State-Trait Anxiety Inventory) was collected. It was observed a significant reduction in the meantime of heartbeats and an increased conductance data in relation to NV×GAMESV. However, no significant differences in cognitive activations were observed. While the use of videos in the psychological and

Correspondence to: **Bruna, Bardella, Soares.** Dirección Postal: Departamento de Ciências do Movimento Humano Universidade Federal de São Paulo- Campus Baixada Santista Eua Silva Jardim 136 Santos . Tel: (013) 3512-2700. Email: bruna.macedo@cpb.org.br

sporting scope may be explored, certain weightings should be considered, knowing that their content may elicit positive or negative responses to performance.

**Keywords:** Paralympic Athlete; Anxiety; Activation; Performance.

## RESUMO

O objetivo desse estudo foi analisar a resposta de ativação cognitiva e fisiológica de nadadores paralímpicos (n= 12) ao assistirem à gravação da sua prova nos Jogos Paralímpicos. O desenho metodológico do estudo foi caracterizado como transversal e realizado em duas etapas. O vídeo conteve três momentos: linha de base (LB), vídeo neutro (VN) e vídeo dos Jogos Paralímpicos (VJOGOS). Durante os testes foram analisados a Variabilidade da Frequência Cardíaca (VFC) e Atividade Eletrodérmica (EDA) como forma de avaliar a ativação fisiológica. Também foram coletados os dados de ativação cognitiva (Inventário de Ansiedade-Estado). Foi observada redução significativa da média de tempo dos batimentos cardíacos e aumento dos dados de condutância em relação a VNxVJOGOS. No entanto, não foram observadas diferenças significativas nas ativações cognitivas. Ao mesmo tempo que o uso de vídeos pode ser explorado, devidas ponderações devem ser consideradas sabendo que seu conteúdo pode eliciar repostas positivas ou negativas ao desempenho.

**Palavras chave:** Atleta Paralímpico; Ansiedade; Ativação; Desempenho.

## INTRODUCCIÓN

The initial purpose of Paralympic sport was rehabilitation, but it expanded and became a high-performance practice (Parsons & Winckler, 2012; Silver, 2012). Due to the recent and continuous increase in competitiveness in Paralympic sports, para-athletes show reduced levels of confidence in pre-competitive situations when compared to athletes without deficiencies, however, both report increased anxiety, which indicates that this is a feeling present in high performance (Alves et al., 2006; Dehghansai et al., 2020; Ferreira et al., 2007).

It should be emphasized that, the more important the event, the higher the level of stress and the possibility of increasing anxiety, requiring from the athlete the ability to perform under pressure dealing with possible adversities. (Coudevylle et al., 2019; García Secades et al., 2017; Jefferies et al., 2012). This factor could be seen in the 2008 Beijing Paralympic Games, in which a higher level of anxiety was observed in para-athletes in the period before their main performance, conditions that may trigger insomnia, reduced sleep time and impairment in physical and cognitive performance (Silva et al., 2012). In addition, swimmers also cope with other stressful sources, such as visual contact with their opponent, hearing their name in the start list, feeling insecure when competing with athletes with better time and performing several events on the same day (Fortes et al., 2017; Samulski et al., 2011).

One of the models that seek to explain the relation of anxiety with performance is the Individual Zones of Optimal Functioning (IZOF), since it considers that athletes have ideal zones of pre-competitive anxiety (low, moderate or high activation); when there is a distance from this zone, performance will probably be impaired (Jokela & Hanin, 1999; Raglin & Morris, 1994). The IZOF vision was extended to emotions, in which athletes may rescue the emotions they felt before, during and after the competition, identifying which ones favoured and which ones impaired their performance, to explain and predict the optimum state in future competitions. Thus, emotions and their intensity are relevant factors (Hanin, 2002; Y. Hanin, 2012; Hanin & Syrjä, 2016; Jokela & Hanin, 1999).

Theoretical explanations related to anxiety and performance are debated in literature, however, some points are constant: anxiety may affect the performance positively or negatively, and should be analyzed individually considering physiological, cognitive and behavioral responses (Ford et al., 2017; Xue et al., 2022). Anxiety-state, a transient condition of the personality, may be assessed by the State-Trait Anxiety Inventory – STAI (Noteboom et al., 2001), which allows to evaluate cognitive activation (Biaggio et al., 1977). Physiological activation can be measured by markers, such as: heart rate, blood pressure and electrodermal activity (Noteboom et al., 2001).

Activation and anxiety can influence sports performance by allowing the athlete to change the ideal zone, generating greater muscle tension, interfering with coordination, attention, confidence and concentration (increase or decrease) (Casali et al., 2021; López Roel & Dosil Díaz, 2019). As a strategy to administrate cognitive (anxiety) and physiological activation, sport psychologists developed training programs, seeking to help athletes prepare for competition with techniques of self-regulation, which include recall methods, using self-report, questionnaires, videos and biofeedback (Blumenstein & Orbach, 2015; Córdoba et al., 2020; Rikberg et al., 2011).

Video recall is an option; pioneer studies use videos in the clinical context, relating physiological parameters with recordings of affective interactions; however, this is still a tool little explored in the sports context, even though it showed efficiency in the precision of recalling volleyball players' pre-competitive anxiety levels (Rikberg et al., 2011). However, momentary reporting may be an inappropriate procedure, since it interferes with the athlete's mental preparation routine, a factor evidenced in a study in which only 50% of cyclists felt comfortable to answers the pre-competitive anxiety questionnaire on the day of the event (McCann et al., 1992).

Biofeedback may be defined as "… a technological-scientific method of stress control that aims to regulate the level of psycho-physiological activation through continuous optical-acoustic feedback of physiological parameters" (Samulski, 2002) Some biofeedback protocols were developed in order to prepare Olympic and Paralympic athletes to perform optimally in competitive environments, and one of the steps of the process was the use of videos of past competitions, in which athletes need to control their activations, that is, their psycho-physiological response through heart rate, electrodermal activity and/or electromyography (Blumenstein & Orbach, 2015; Dihor et al., 2020).

Electrodermal activity (EDA) and heart rate variability (HRV) are considered valid parameters to observe the emotional response of athletes (Morales et al., 2013; Wilson et al., 2017). EDA is a peripheral index sensitive to the activity of the sympathetic nervous system that detects alterations in the electrical conductivity of the skin, while HRV describes the oscillations of intervals between consecutive heartbeats (R-R intervals) (Aubert et al., 2003; Cacioppo et al., 2007)

Based on the IZOF theory, on video recall methods and the effect of physiological and cognitive activation, so that high-performance Paralympic swimmers reach and manage their optimal zone, this study aimed to analyze the use of videos as a way to assess the activation of swimmers before, during and after watching the 2016 Paralympic Games video. It was hypothesized that athletes would demonstrate physiological and cognitive when watching the competition video when compared to the previous state.

## MATERIAL Y MÉTODOS

The study was approved by the Research Ethics Committee of the Federal University of São Paulo (no.:1284/2018). All participating athletes signed the Informed Consent Form after agreeing to participate in the study. The athletes were informed that they could stop the procedure at any moment if they felt any discomfort, and their data would be discarded without any harm.

### *Participantes*

This study evaluated 12 para-athletes from the Brazilian Paralympic swimming team, who participated in the 2016 Rio Paralympic Games, being four females and eight males. Among the para-athletes, four were medallists in this event, five reached the finals and three competed in the qualifying matches. The mean age of the participants was 27.80±8.50 years, and training time was 16.75±9.09 years. Inclusion criteria: athletes who have the recording of their performance in the 2016 Rio Paralympic Games available on the page of the International Paralympic Committee. Exclusion criteria: athletes with visual impairment, intellectual disability, quadriplegia, or undergoing new medical treatment. The functional classifications of the participants were divided as follows: one S3, one S4, two S5, one S7, two S8, four S9 and one S10.

### *Instrumentos*

#### *State-Trait Anxiety Inventories (STAI)*

Spielberger et al., (1970) developed an anxiety scale named STAI, which was validated for Portuguese by

Biaggio et al (1977) translated as Inventário de Ansiedade Traço-Estado (IDATE). The STAI is composed of two scales (state and trait), containing 20 statements with scores between 1 and 4 points, with a minimum score of 20 points representing low anxiety, and maximum of 80 points for high anxiety. According to the authors, the trait scale seeks to identify how the subject usually feels, and the state scale how they are feeling at a given time. Noteboom, et al. (2001) described anxiety-state as a cognitive activation, using the STAI-state as a form of evaluation, the same concept used in this study.

### *Video*

The videos were composed of three moments, each lasting three minutes, and separated by a black transition screen lasting 15 seconds. The first video was the baseline (BL), in which an image corresponded to a black screen; the second showed the Neutral Video (NV), a recording of images and sounds in a corner between two streets in which people walked and vehicles passed; there was the noise of vehicles, of people talking and walking on the street. Images and sounds were the same for all subjects in BL and NV. Finally, in the Game Video (GAMESV), it was showed one of the events that the swimmer took part in the 2016 Rio Paralympic Games, available on the YouTube channel of the International Paralympic Committee. The video was edited to contain three minutes according to the duration of the event. The start list and the end of the event were included when the event lasted less than three minutes, with the sound of the narrator commenting on the event in English and the fans that attended the event.

### *Evaluation of physiological activation*

The para-athlete watched the videos sitting in a comfortable chair and was told to avoid any movement while watching them, being instructed to turn off mobile phones and warned that the procedure could be stopped at any moment in case they felt any discomfort, and their data would be discarded. The procedure occurred without interruptions, and data collection was performed with the same researcher who maintained the conditions and instructions for all subjects.

Heart rate variability was obtained using the EmWave Pro Plus Assessments by Heart Math. The validation of the equipment was shown by a study that compared a gold-standard reference equipment, BioPatch, used as train traffic controlers, demonstrating its accuracy (Lo et al., 2017; Whited et al., 2014). Electrodermal activity was recorded through the use of galvanic conductance sensors, recorded by the Procomp2 equipment by Thought Technology, which captures 32 samples per second, measured in microsiemens (Bontchev, 2016; Lincoln et al., 2015). The EDA sensors used in this study were made of silver and silver chloride, Ag/AgCl, with 3.5 cm in exosomatic measurement, and contained adhesive Velcro to adjust to the size of the fingers.

The EDA and HRV sensors were sanitized with alcohol, and the skin of each subject with water; according to the manufacturer recommendations, no electrolytes were used to improve conduction. EDA sensors were coupled to the distal phalanx of the middle and index fingers of the non-dominant hand of the Para athletes, except for those with only one hand; in this case, the sensors were placed on the single hand, and the HRV pulse sensor was fixed on the earlobe opposite to the EDA sensors to avoid interference.

Ectopic heartbeats or artifacts (movement and noise) may interfere with data analysis, so heartbeats with deviations greater than 20% were manually interpolated (Oliveira et at., 2012). Subsequently, data were added to the Kubios Software to analyze the HRV by adopting the threshold (medium) artifact correction method. The HRV data were analyzed both in relation to raw data from NV and GAMESV, and percentage variation (MRR%, RMMSD% and pNN50%) of NV and GAMESV from BL. In relation to EDA, data that showed a signal increase greater than 20% per second and reduction greater than 10% per second were excluded, it's a way to remove positive and negative spikes (Kocielnik et al., 2013). To analyze the phasic response of electrodermal activity, the area was calculated (base × height) of each individual. This parameter evaluates both the amplitude of the emotional response and its duration (Boucsein et al., 2012).

### *Procedimiento*

The methodological design of the study was characterized as cross-sectional and carried out in two stages (Figure 1), which were: familiarization and intervention. In the first, para-athletes were instructed on the procedures of the study, presented to the biofeedback equipment, informed about the questionnaires, stages of the videos (content and time), without specifying the competition and the swimming style, and, finally, instructed to avoid physical exertion the night before, and to avoid the use of coffee or other stimulants in the hours before the test. The procedure lasted approximately 10 minutes.

In the intervention stage, the evaluations were carried out in the morning before the sports training, keeping the order of the videos and watching all at the same meeting to avoid changes in emotional state from one day to the next. The procedures of that day were as follows: Pre-Video, Video and Post-Video. In the Pre-Video, the athlete answered the demographic data questionnaire and the STAI-state questionnaire. In the Video procedure, HRV and EDA sensors were added, and the quality of the signals was tested until the beginning of the three videos. At the end of the videos, the sensors were removed, and the athlete responded again to the STAI, corresponding to the Post-Video. This step lasted approximately 50 minutes with each athlete. The intervention stage was conducted between two and three years after the completion of the Paralympic Games.

Each participant was evaluated individually, one per day. Tests were performed in a closed room air-conditioned to a temperature of 23°C, and the procedure took place without interruptions. Data collection was carried out with the same researcher who maintained the conditions and instructions for all subjects.

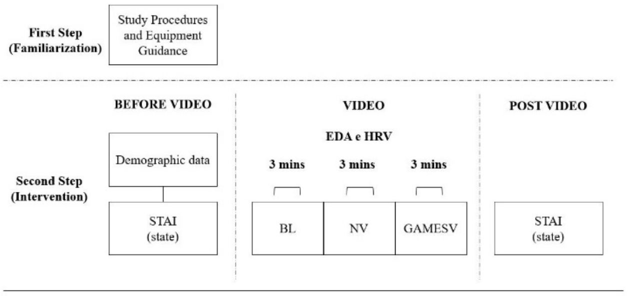

Figure 1. Methodological Design.

### *Análisis estadístico*

Data were tested regarding their normality distribution with the Shapiro-Wilk test. HRV (MRR, RMSSD, pNN50 and MRR%) and STAI-state values demonstrated normal distribution, so, the paired t-test was used. The percentage variation of HRV (RMSSD% and pNN50%) did not show normal distribution, so the Mann-Whitney test was used. The values of electrodermal activity also did not have a normal distribution, thus, a logarithmic transformation was performed, as recommended, then, the paired t-test was applied to analyze the phasic response (Boucsein et al., 2012). Effect sizes (ES) and 95 % confidence intervals (95 % CI) were calculated to establish the meaningfulness of any differences. ES of above 0,8, between 0,8 and 0,5, between 0,5 and 0,2 and lower than 0,2 were considered as large, moderate, small, and trivial, respectively (Cohen, 1988).

## RESULTADOS

The physiological activation analyzed through the HRV results showed a significant difference in the MRR variable between the conditions NV vs. GAMESV [t (11)=4.60, p = 0.0008], with a reduction of time between each heartbeat in GAMESV and ES was small (-030). In the RMSSD, [t(11)=1.52, p=0.15), and pNN50 [t(11)=0.85, p=0.41] variables, there was a non-significant reduction in the parasympathetic parameters in the GAMESV when compared to NV, the results of which may be seen in Table 1. The ES respectively was small and trivial. With respect to the variables with percentage variation, MRR% showed a significant reduction in GAMESV compared to NV [t(11)=4.68, p=0.0007)], with a variation of -7.34 ±4.62% for GAMESV, and -0.67±2.72% for NV and ES was small (95 % CI =0,02). When analyzing RMSSD% (p=0.51), a variation of 3.12±31.34% with small ES (-0,037) in NV and -10.42±18.71% in GAMESV was observed, pNN50% (p=0.97) with a variation of -6.76±19.21% in NV and -7.95±31.95% with trivial ES (-0,03) in GAMESV, without significant differences. Results are shown in Figure 2, demonstrating the percentage variation in each video (Figures 2.A, 2.B and 2.C).

Table 1: Results of physiological activation.

| HRV | NV | GAMESV | p | ES | 95 % CI |
|---|---|---|---|---|---|
| **MRR (ms)** | 917,92 ±138,13 | 858,08±142,58* | 0,0008** | -0,30 | 90,58 |
| **RMMSD (ms)** | 62,43±23,35 | 54,36±20,25 | 0,15 | -0,26 | 12,86 |
| **pNN50 (%)** | 35,57±19,50 | 32,67±17,17 | 0,41 | -0,11 | 10,91 |

Note. Results of analysis of the parameters of Heart Rate Variability (HRV) including Percentage variation of the mean of R-R intervals (MRR), Percentage variation of the root mean Square of interval differences (RMMSD), percentage variation of successive RR intervals that differ by more than 50 ms (pNN50) in both situations Neutral Video (NV) and Games Video (GAMESV), p value, Effect Size (ES) and 95 % confidence intervals.

In the activation by EDA, the results show that there was a statistically significant difference between the phasic responses generated by the stimuli in NV and GAMESV [t(11)=3.88, p=0.0026], and the one generated by the variation of conductance level for the stimulus in GAMESV (4.34±0.13%) was greater than the area observed in NV (4.24 ±0.11%). Data are expressed in Figure 2 (Figure 2.D). The ES was moderate (-0,61) (95 % CI =0,63).

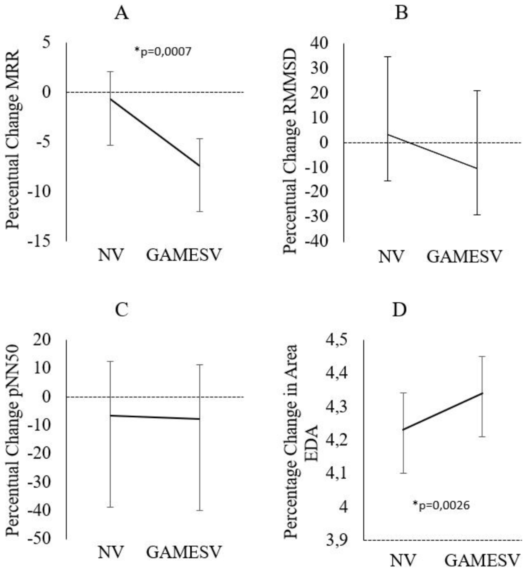

Figure 2. Percentage variation of the physiological activation of HRV and EDA data in relation to the baseline in the two videos (NV e GAMESV).

When analyzing the level of cognitive activation before and after the intervention, no significant differences were observed [t(11)=0.70, p=0.50]. The mean anxiety-state values before watching the videos was 41.83±11.01, and, after watching the videos, it was 40.17±11.00, the ES was trivial (0,11) (95 % CI =6,99).

## DISCUSIÓN

This study sought to understand the physiological and cognitive activation of para-athletes when watching recordings of their performance during the 2016 Paralympic Games. When analyzing physiological activation, it was observed that the time between heartbeats reduced significantly when swimmers were exposed to the video of their competition, while the response of the electrodermal activity increased. Moreover, parasympathetic parameters were reduced, although not statistically significant (RMMSD and pNN50).

The response of the significant variation of galvanic conductance during GAMESV corroborates the results in which students and workers of a Dutch University showed sympathetic activation in short (2/3 minutes) and long (9/10 minutes) videos with anxiety content, while the video with a sad content did not elicit significant responses (Kuijsters et al., 2016). Another study that showed similar results was the one by Gomez et al., (2005), in which videos with high activation content generated higher response of electrodermal activity, including those that used distinct sports scenes associated with pop and rock music on the background. Although GAMESV does not discriminate emotions, the study by Marci et al. (2007), in which subjects were exposed to audios of autobiographic scripts, showed results similar to Para athletes with increased electrodermal response to memories with anger content, while those of joy and sadness showed no significative differences.

Regarding parasympathetic variables (RMMSD and HR), no significant differences were found in the findings of Kuijsters et al., (2016), which is similar to this study when analyzing RMMSD. Possibly, the reduced sample number of both studies and the type of stimulus (audiovisual) may influence the responsiveness of parasympathetic variables.

MRR is one of the physiological variables analyzed by this study that is inversely related to HR; the higher the MRR, the lower the HR and vice versa. In the studies mentioned above, both in the short video with anxious content, in the emotional images and in the videos with positive and negative content and low activation, reductions in heart rate were observed (especially in videos with negative content), which is different from that seen in GAMESV, suggesting that emotional content increases and HR decreases (Gomez et al., 2005; Kuijsters et al., 2016). This factor can be observed in a study performed with individuals with anxiety and mood disorders, in which HR decreased during a negative mood eliciting film in subjects who used thoughts of acceptance to the content, using higher cognitive demand, different from the suppression group, who tried to avoid the content of the film, increasing HR during exposition (Campbell-Sills et al., 2006).

However, in a study on autobiographic reports with auditory stimulus, a reduced MRR was also observed during both stimulus (joy and anger), which was also seen in GAMESV, although without discrimination of emotion (Marci et al., 2007). Possibly, the proximity with the content of stimulus, even if only an auditory one, may be associated with the stimulus content; in a certain way, GAMESV refers to a memory experienced by the individual, close to an autobiographic account.

No studies were found detailing results of video observation with sports content, in which psycho-physiological variables were assessed, unless using other stimuli, such as in the study of Blumenstein et al., (1995), in which there was an increase in electrodermal response and HR when individuals imagined themselves (guided by an audio) preparing to run an 100-meter event; however, these data were observed after performing a relaxation training, different from this study, which used NV in advance and a visual stimulus (Blumenstein et al., 1995).

In the competition environment, swimmers in pre-competitive situations showed inhibition of parasympathetic activity (reduced RMMSD) and increased sympathetic activity when analyzing the indexes in the frequency domain (ratio of low and high frequency) (Blásquez et al., 2009). Fortes et al. (2017) also observed reduced InRMMSD (RMMSD transformed into logarithmic) and pNN50% indexes in athletes with higher levels of pre-competitive anxiety. Both findings were different from those observed in GAMESV, probably due to the number of the sample and contextual difference, since the studies were performed during a competition, in which the stress and anxiety level is higher than that observed in a laboratory during a video (Fortes et al., 2017). Therefore, the results show how important it is for athletes to understand what their reaction to stimuli are, in order to learn to control their emotions, since the physiological activation alone is not necessarily harmful, it depends on the optimum state of the athlete and their self-regulation capacity (Gross et al., 2018).

The investigated aspect, level of cognitive activation of para-athletes before and after the intervention, did not show significant variations. This pattern of response was similar to the study in which soldiers showed sympathetic activation (LF) and parasympathetic reduction (HR and RMMSD) during a combat simulation; they did not observe significant differences in the cognitive activation by the Anxiety-State Inventory before and after the simulation, although that study did not observe parasympathetic reduction (Delgado-Moreno et al., 2019). In the perspective of Mauss and Robinson (2009), discrete emotions do not have autonomic signatures, that is, it is not possible to identify the emotion through the physiological response of EDA and HRV, only the valence. Therefore, para-athletes may have experienced other emotions during GAMESV, different from anxiety, such as anger or joy, which may also activate the sympathetic system. Another possibility is that cognitive activation was not consciously perceived by the para-athlete; there are studies showing autonomic activation to stimuli not consciously perceived, suggesting that psycho-physiological markers may show an unconscious emotional reaction, therefore, not sensitive to the questionnaire (Sequeira et al., 2009; Silvert et al., 2004).

## CONCLUSIONES

In summary, were observed increased sympathetic activity in the level of skin conduction, and reduced mean time between heartbeats, showing that the GAMESV caused a physiological activation when compared to NV. No differences were found regarding the level of cognitive activation, RMSSD and pNN50%. While the use of videos and psycho-physiological variables in the psychological and sports context may be explored, certain weightings should be considered, knowing that their content might result in positive or negative psycho-physiological responses to the athlete's performance.

## APLICACIONES PRÁCTICAS

Finally, paying attention to practical applications, it is necessary to reflect on the use of videos both as a way to motivate the athlete and in sportive psychological monitoring; while the use of videos may be expanded, it also requires care, knowing that it may elicit a positive or negative psycho-physiological response for the performance. In the psychological area, it is possible to reflect on its use in self-regulation trainings, suggesting further studies on the topic (Schlatter et al., 2021).

It is important to understand that physiological activation is related to the emotional state of the athlete; depending on their ability to self-regulate, the athlete may leave their optimal zone of performance, that it, the effects observed in GAMESV may modify the state of the athlete, taking them out of their zone (Hanin, 2012). In addition, sports preparation aims at the best execution of movements in target competitions, as the Paralympic Games, in which the effects of activation level are greater than those generated by recordings inside a laboratory; however, data collection on competition days of this magnitude may be difficult, since the athletes often have a previously established routine, in which any change may interfere in their concentration (Olmedilla-Caballero et al., 2020; Samulski et al., 2011).

Another reflection would be the possibility of using recordings such as GAMESV to establish a baseline and work the desensitization of the effects of the video, aiming at controlling physiological activation, a practice that was used with soccer players in the "Mind Lab", with the Rhythmic Gymnastics team of the United States and in protocols of induction of a stressful task (Blumenstein & Orbach, 2015; Gross et al., 2018; Wilson, V. E.; Peper, E. & Moss, 2006). The individuality of each athlete must be reinforced, reacting in a unique way to a certain variable.

About the limitations of the study, the number of subjects and the analysis of only one Paralympic modality, swimming, may be restrictive factors. Furthermore, the competition used was the 2016 Games, that is, the time of competition and time of exposition to the video may modulate the psycho-physiological response of the athletes, as well as the fact that it was a competition at home, in which Brazilian Paralympic athletes competed in their own country. Consequently, studies with recent competition videos should bring other results, as well as a greater number of individuals, using standardized videos to compare the physiological parameters in relation to the duration of the video (pre-, during and post-competition). The results of Campbell-Sills et al., (2006) reinforced this analysis, which shows that both HR and EDA may vary at different moments: before, during and after the exposition to the video, which may be explored in the sports context outside the laboratory.

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