# An exploration of heart rate and perceived exertion differences between class and competition in freestyle-disco dance

# An exploration of heart rate and perceived exertion differences between class and competition in freestyle-disco dance

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**Abstract** Freestyle-disco is a relatively new and complex competitive dance style that, to our knowledge, has yet to be researched. Thus, the purpose of this research was to explore two fundamental physiological characteristics of exercise in relation to freestyle-disco as a starting-point for future research into the style. From this, the authors hope to better understand the processes and complexities involved in studying these particular dancers. This study investigated differences in heart rate (HR) and ratings of perceived exertion (RPE) between class and competition in freestyle-disco and slow dance. Five female dancers aged 12 to 16 years, from one freestyle-disco school volunteered to participate in the study. HR data were recorded using heart rate monitors at two classes and two competitions. RPE scores were collected after each competitive performance and each section of the class. No significant differences in HR or RPE were found for freestyle-disco or slow dance performance between class and competition. The methodological limitations that arose in this work means that these findings are merely speculative however they do provide initial insight to an under-researched dance style. As such, we hope this research will be a catalyst for further investigation to learn more about this exciting dance style.

Keywords: dance; freestyle-disco; heart rate; perceived exertion; dance class; dance competition

## Introduction

### *A brief history of freestyle-disco*

Freestyle-disco is a relatively new dance style, launched from the popularity of the 1977 film 'Saturday Night Fever' (Jones 2010). In the book titled 'Freestyle Dance' (Jones 2010), which is used by teachers to study for their teaching qualification, author Anna Jones explains how classes began as a way for the public to learn John Travolta's famous moves. From this, the International Dance Teachers' Association (IDTA) developed examination syllabi and initiated competitions. Soon after, the Association of Dance and Freestyle Professionals (ADFP), together with the British Dance Council (BDC), was founded as a controlling body responsible for rules and regulations of competitions. Competitions are run weekly nationwide, and many festivals and championships are held across the competitive calendar. Over the years, the style has expanded outside of the UK with some of the top talent emerging from Ireland and Norway (Jones 2010).

### *Technical elements*

Freestyle-disco is a style that allows dancers and teachers freedom to choreograph a wide variety of movements from across a range of styles. Movements to disco music in the late 1970's were exaggerated, eye-catching and involved a lot of gyrating. This has progressed into a much more athletic and striking style involving kicks, spins, runs, jumps, and gymnastics. Music is decided by the promoter/DJ of a competition and will usually be remixed chart and club/dance music reaching 150-170 beats per minute, emphasising a repetitive heavy bass beat.

Solo rounds can last anywhere between 30-75 seconds and dancers may be asked to dance a number of separate rounds, with unknown and differed rest periods between rounds. Finalists may be asked to complete 'solo-spots' that last for 12 bars of music or

20 seconds. During rounds, dancers will perform alongside many other dancers. Stylistically, movements in freestyle-disco should be fast and powerful.

Slow dance is another element involved in freestyle-disco. Characteristics are progressively conforming to those of contemporary/lyrical dance, but to popular music of a slower tempo (~60-100bpm). Emphasis is placed on emotive portrayal, balance, flexibility, and strength. Rounds may last up to 90 seconds, and 'solo-spots' last 40 seconds (BDC and ADFP 2017).

***How might the demands of freestyle-disco compare to other dance genres?***

Many genres of dance have been classified as high-intensity intermittent exercise (Beck, Redding and Wyon 2015). However, most literature in dance is based on ballet and contemporary styles where performance tends to be more continuous at a moderate intensity for long periods (~40-90 minutes) with brief bursts of high-intensity, isometric exercise (Cohen 1987, 74). Rest periods in performances of these styles tend to be shorter than those experienced by dancers at a freestyle-disco competition where it is unknown how long dancers will wait between each performance.

Physiological characteristics of dance class have been widely reported in ballet and contemporary dance. Due to their stop-start nature, classes have often been described as intermittent and ranging in intensities dependent on the section of class (Wyon, et al. 2002; Beck, et al. 2015). It has been consistently reported that the mean intensity of warm-up and barre phases of class have been significantly lower than in centre/execution phases (Beck, et al. 2015; Cohen, et al. 1982; Schantz and Astrand 1984; Wyon, et al. 2002; 2004). In a review of ballet physiology, Emily Twitchett and colleagues (2009) discovered that during the centre sections of class, dancers' mean peak heart rate reached

94% $HR_{max}$. The same could be expected of a freestyle-disco class as they follow a similar format of varied activities and intensities.

Performance structures of classical dance styles and freestyle-disco are notably different. Classical performances may last between 5 minutes and 2 hours, where dancers usually perform at a steady intensity with short, high-intensity bursts (Schantz and Astrand 1984). Freestyle-disco performances appear to be of maximal intensity, lasting around 60 seconds, and are usually separated by longer rest periods.

Previous literature investigating heart rates in dance activity report similar patterns in class and performance. Recorded heart rates in ballet and contemporary classes neared maximal levels for short bursts (Cohen, Segal, et al. 1982), constituting 52% of class time (Rimmer, et al. 1994 cited in Wyon, et al. 2002). In this research by Rimmer, peak heart rates reached over 85% $HR_{max}$ but this was only sustained for around 2 minutes of an 80-minute session. Similarly, heart rates found in DanceSport dancers at a competition were found to be consistently near maximal, with the highest heart rates recorded in the last dances of the round (Liiv, et al. 2014). Likewise, in highland dance (Baillie, Wyon and Head 2007), mean heart rates of each performance piece during competition all exceeded 190 $b.min^{-1}$.

It is widely believed that dancers are not reaching the cardiorespiratory levels reached in performance when in class (Hamilton 2008; Rodrigues-Krause, Krause and Reischak-Oliveira 2015). In previous work on ballet and contemporary dance, authors have consistently reported significantly higher heart rate recordings during performance than throughout class (Redding and Wyon 2003; Wyon 2005; Wyon, et al. 2002; 2004; Wyon and Redding 2005). For example, research conducted by Rimmer et al. (1994, cited in Baillie, et al. 2007) found dancers training at over 70% $HR_{max}$ for 50% of class time, but were not achieving the level of high-intensity bursts that had been recorded in

rehearsals. It is important to discover whether dance classes are meeting the demands of performance because a high frequency of injuries have been attributed to inadequate fitness levels (Brinson and Dick 1996; Koutedakis, et al. 2007; Rodrigues-Krause, et al. 2015; Twitchett, et al. 2010; Wyon, et al. 2007; Wyon and Koutedakis 2013).

Little to no research has been done in competitive dance in order to discover whether the characteristics discussed are also representative of these dance forms. To our knowledge, no research has previously been conducted in freestyle-disco; a style that has become increasingly athletic and complex placing great physiological demands on the dancer. The style could therefore benefit considerably from scientific research in terms of both performance optimisation and safety within dance practice. Thus, this research will look to initially explore two fundamental physiological characteristics of exercise in relation to freestyle-disco as a starting-point. From this, the authors hope to provide a better understanding of these physiological processes within the dance form whilst also exploring the complexities involved in studying this particular group of dancers. The research will also explore how technologies involved in exercise testing might work in relation to this energetic dance style and pinpoint limitations they may present to future research. As such, this research aims to investigate the heart rates and perceived exertion of a small group of dancers during different activities both in class and at competition in order to gain further insight as to whether training meets the demands of competition. The research will also investigate whether there is a relationship between heart rate and ratings of perceived exertion, based on theories that individuals are able to subjectively recognise different exercise intensities (Borg 1970); becoming aware of indications of fatigue or feeling a faster heartbeat.

## Methodology

### *Participants*

Five female freestyle-disco dancers from one dance school, aged between 12 and 16 years of age, volunteered to participate in this study. Participant anthropometrics and dance experience information has been summarised in Table 1.

Table 1. Participant anthropometrics and dance experience information expressed as mean ± SD ($n$ = 5)

| Variables | Mean ± SD |
|---|---|
| Age (years) | 14 ± 1.87 |
| Height (cm) | 155 ± 3.76 |
| Weight (kg) | 49.3 ± 7.11 |
| Total years dancing | 10.4 ± 1.52 |
| Years dancing freestyle-disco | 5.4 ± 3.44 |
| Hours training freestyle-disco per week | 4.6 ± 1.07 |
| Hours training other dance styles per week | 0.7 ± 0.42 |

### *Instrumentation*

Polar Team$^2$ heart rate monitors (Polar, Finland) were used to collect heart rate values at beat-to-beat intervals. Ratings of perceived exertion (RPE) were given verbally by each participant following Borg's scale of perceived exertion (Borg 1970). These values were given in private to avoid participants copying peers' answers. Participants were shown the scale every time a value was required and were reminded to give answers that they felt were accurate and not what they think they should answer.

### *Protocol*

The design of this study followed the design of a similar study conducted by Baillie et al. (2007), whereby heart rate and blood lactate levels were compared between competition

and class in highland dance. As dancers tend not to participate in other types of activity, it is most appropriate to observe and measure them during dance activity.

Testing took place at two training classes, as per usual schedule, and two competitions, also as scheduled previously by the dance teacher. The training classes attended were either the day prior to a competition or the day following. It was not possible to attend classes the same side of competitions due to the dance school's summer schedule. The competitions attended were 3 weeks apart. Both classes were held at the dance school in Milton Keynes, UK. One competition was held in Southampton, UK and the other in Lincoln, UK.

Anthropometrics and dance experience/schedule details were recorded prior to the first class. Heart rate monitors were fitted, and participants were asked to make the investigator aware if the monitor was slipping or uncomfortable. Participants were then reminded of the procedure for the session and had explained to them Borg's scale of perceived exertion.

Class was completed as usual, and during rest breaks participants gave the investigator their RPE score. Notes were taken by the investigator of duration and characteristics of activities, in addition to any extra periods of rest taken (such as, toilet breaks) by individuals. On competition days, heart rate monitors were fitted in the same way, and participants were reminded of Borg's scale. Ratings were given following each performance round. Notes of the start and finish times of each performance were recorded. Rest periods were noted only as the periods between performances. These periods also included dancers warming up/cooling down, toilet breaks, eating, playing etc.

This project followed the British Association of Sport and Exercise Sciences Code of Conduct and has received ethical approval from the Moray House School of Education Ethics Committee at The University of Edinburgh.

***Statistical analysis***

Descriptive statistics were used to analyse participant anthropometrics and dance experience information (Table 1). Repeated-measures ANOVA was used to analyse mean heart rates, maximum heart rates and recorded RPEs for freestyle-disco solo performances so results could be standardised for competitions and classes. It was necessary for comparisons to be made between data collected from the competitions and classes as none of the participants were able to attend all four sessions. Paired t-tests were used to analyse the same data for slow dance at a competition, as only two dances were performed. Following standardisation, repeated-measures ANOVA tests were used to compare the averages of mean heart rates, maximum heart rates, and RPE scores from class and competition for solo freestyle-disco and slow dance performances. Finally, correlational analyses were conducted to investigate whether there were any relationships between heart rate and RPE scores. Data are described as mean SD. When expressing any values as % $HR_{max,}$ $HR_{max}$ was an estimation using the age-predicted calculation of 220-age. It was not possible to measure actual $HR_{max}$ due to the young age of the participants, thus preventing maximal testing. Research has shown that the age-estimated equation achieved similar results to actual maximum heart rate measured when compared (Blanksby and Reidy 1988; D'Ottavio, et al. 2016). Due to the small sample size, the Shapiro-Wilk test for normality was conducted for all data sets and confirmed that the data were normally distributed ($p$ >.05). Statistical analysis was performed using IBM SPSS Statistics 22 Software. The level of significance used to accept or reject the hypotheses was 0.05.

## Results

### *Characteristics of class and competition*

The classes observed followed a somewhat similar structure and were taught by the same teacher. The sessions began with a warm-up lasting around 10 minutes and included aerobic activity and dynamic stretching. The first class focused more on static and dynamic stretching in the warm-up, whereas the second class consisted of more strength and conditioning activities. Both classes allocated time to 'free practice' where music was played, and dancers were expected to practise routines and skills for both freestyle-disco and slow dance. But time spent on free practice differed between classes: the first class totalled 7.5 minutes of free practice and the second totalled 13 minutes. Additionally, time was allocated for completion of dance rounds – mimicking a competition round of each style. This activity was intermittent in nature as rounds were danced by 2 or 3 dancers at a time, whilst others rested. Rounds varied in duration with some lasting 30 seconds and some lasting over 60 seconds. Following this in the first class, skill drills were completed for around 12 minutes for slow dance technique and 3 minutes for freestyle-disco technique. No technique practice was performed in the second class. This activity was replaced for a slow dance choreography task, where dancers learnt a short piece of choreography and were required to create and add on an extra few bars of their own choreography to perform.

Competition structures followed different formats but lasted similar amounts of time. Both began with freestyle-disco solos, in which all dancers in attendance competed. The first competition followed up with freestyle-disco pairs and slow pairs events; only one participant competed in these. The second competition also held a pairs event in addition to a Rock 'n' Roll event, the same 2 participants competed in both of these events. Both competitions were held during the summer months and temperatures were

somewhat hot, around 21ºC outside. The first competition was held in a sports hall with no air conditioning or cooling available, making conditions rather uncomfortable. The second, however, was held in a sports hall where temperature was cool and maintained by air conditioners. With regard to competition standards, the largest competition rounds were observed for 'beginners' and 'starters' at both competitions. The music at the first competition averaged at around 150bpm in freestyle-disco. At the second competition, music for freestyle-disco and slow dance was much more up-to-date and faster (between 160-175bpm for freestyle-disco), which dancers were happier with.

Figures 1 and 2 illustrate the heart rate patterns of four of the dancers for a class and for a competition. It was not possible to make this comparison for one of the participants due to the heart rate monitor not recording any data for the class in which most participants were present. In figure 1, different sections of the class have been annotated: a – warm-up, b – strength & conditioning, c – stretch & conditioning, d – free practice (freestyle-disco & slow), e – freestyle-disco rounds, f – slow rounds, g – free practice (freestyle-disco & slow), h – slow choreography task. In figure 2: a – freestyle-disco warm-up round, b – freestyle-disco semi-final, c – freestyle-disco final, d – slow dance warm-up round, e – slow dance semi-final, f – slow dance final. Not all dancers completed all rounds at the competition due to not getting recalled or depending on how many dancers were in the event. All dancers follow a similar heart rate pattern with highest heart rates reached during 'warm-up', 'stretch & conditioning', 'freestyle-disco rounds' and 'slow dance rounds' sections in class. Additionally, heart rates reached near-maximal levels (> 85% $HR_{max}$) during each round at a competition, irrespective of dance style, returning to resting levels between rounds. It appears heart rates did not return to resting level at any point throughout the class, and dancer C reached heart rates above the age-estimated maximum.

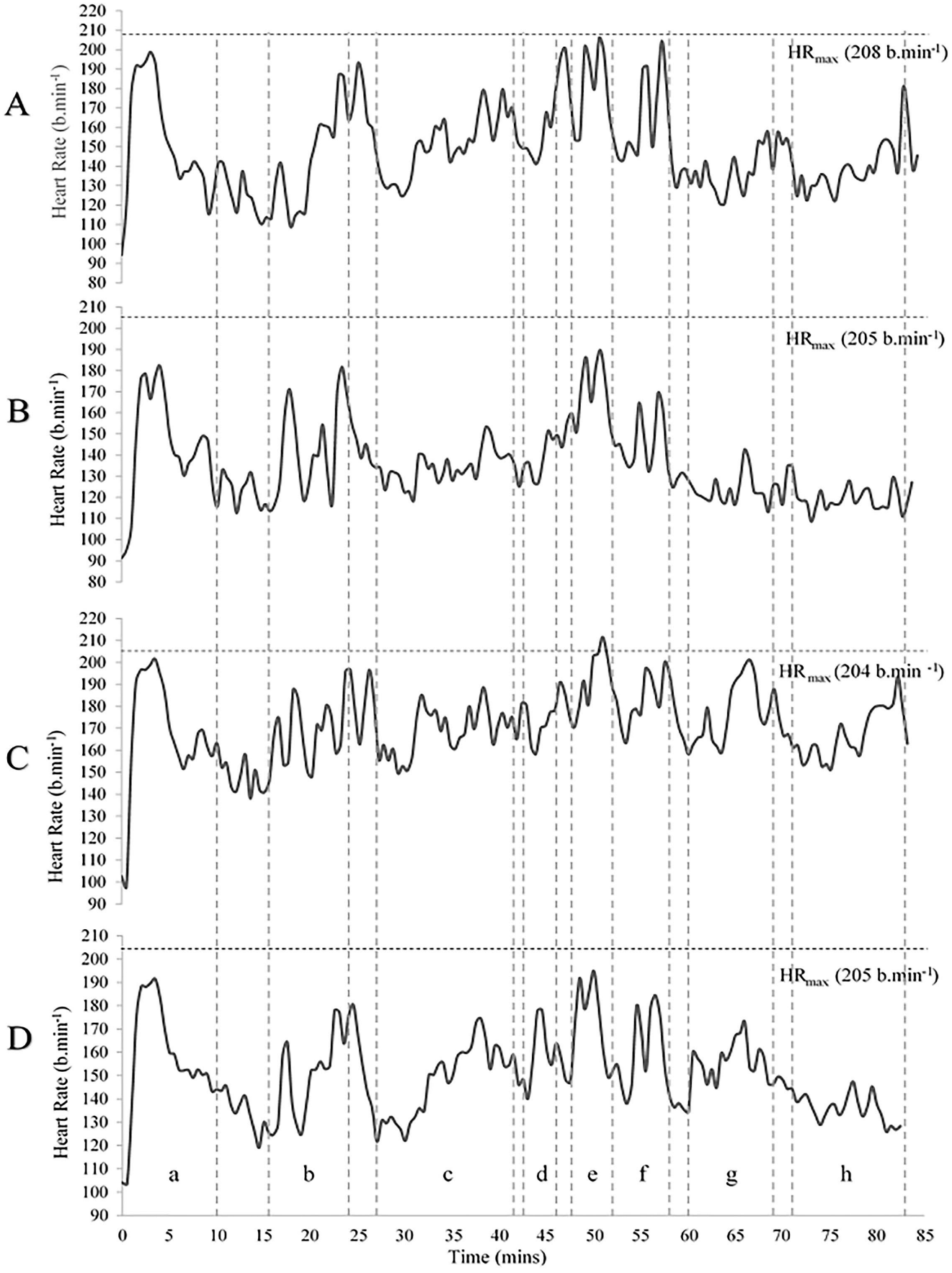


Figure 1. Heart rate recordings (b.min$^{-1}$) from the second training class ($n$ = 4). A-D signify each participant. a-h represent different activities in class, remaining blank sections are rest periods

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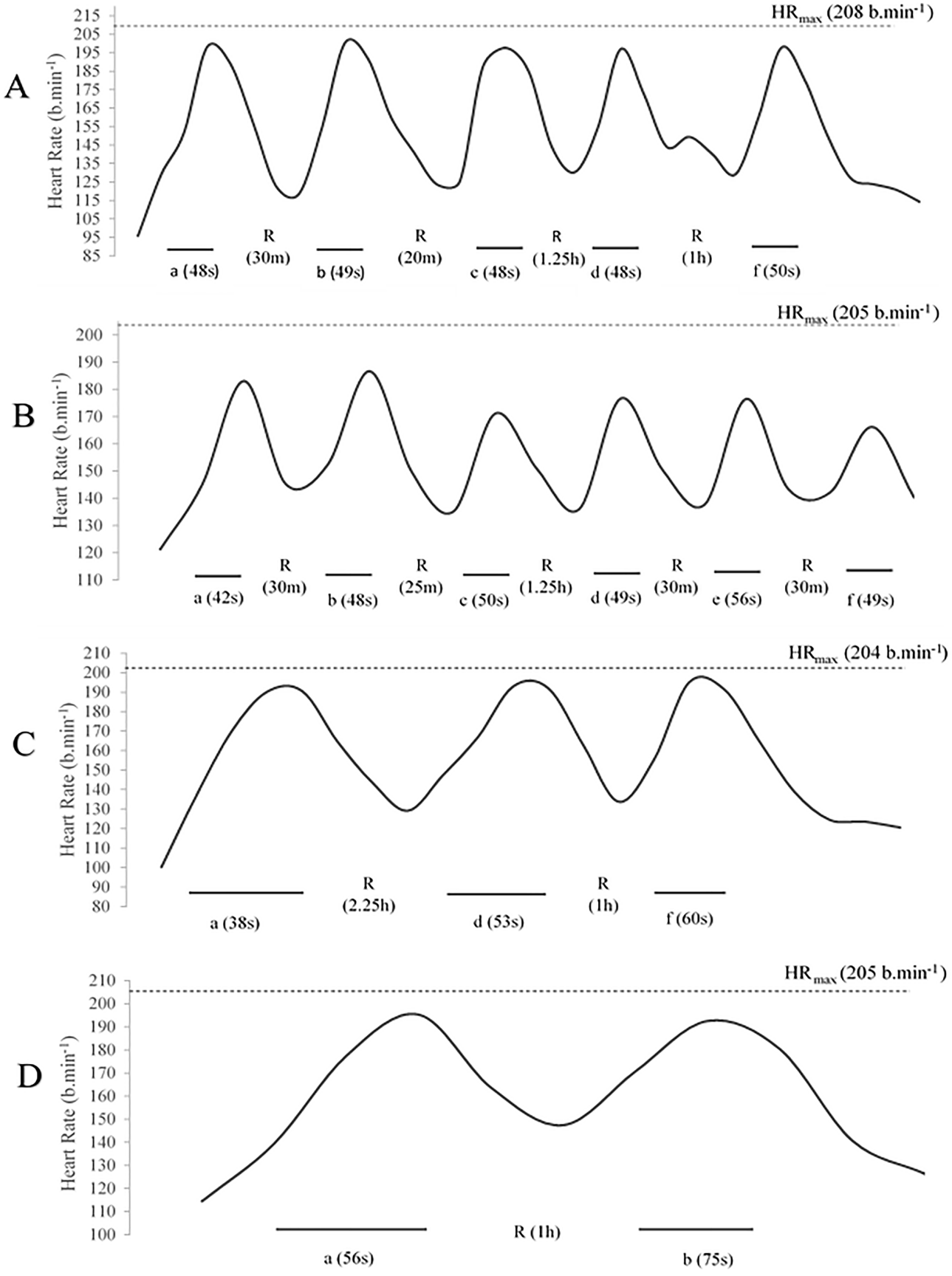



Figure 2. Heart rate recordings (b.min$^{-1}$) from a competition ($n$ = 4). A-D signify each participant. a-c represent different solo freestyle-disco rounds and d-f for slow rounds (time of round), R signifies rest periods (time).

1

Class structure could somewhat be compared to a ballet class, where in exercise is intermittent, with varying periods of work and rest. And intensities of activities could be separated in a similar way to the barre/centre structure of a ballet class, as described by Cohen (1987, 74), where conditioning and technique mirror the 'barre' section and mock rounds mirror the 'centre' section. Cohen has classed ballet as moderate- to high-intensity exercise, for barre and centre exercises, respectively. It is also classed as non-endurance, like gymnastics and wrestling or sprinting. These characteristics could also be used to describe freestyle-disco.

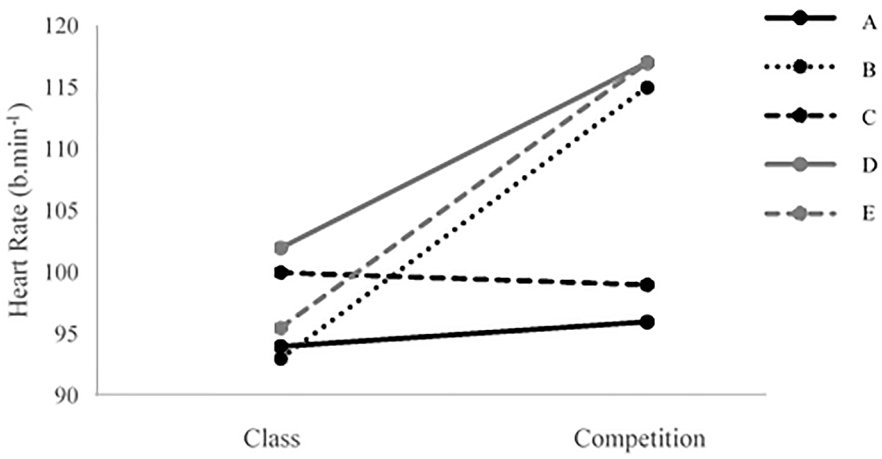
***Standardisation***

From the group ($n$ = 5) four complete data sets were recorded as challenges arose with the fitting of the HR monitors as the dancers were all very slight. Three of the group were able to attend either both classes or both competitions. The data were analysed and standardised using the available data. No significant differences were found between the classes or between the competitions for each dancer ($n$ = 3) that participated in multiple classes or competitions ($t(2) = -.277$, $p > .05$, $r = .94$). This result allowed for data for the participants to be combined to provide averages for other statistical analyses.

***Heart rate***

Resting heart rates (RHR) were recorded prior to each session and were analysed to investigate any significant differences. No significant differences in RHR were found between the competitions or between the classes for dancers that attended both competitions or both classes, $t(2) = -2.07$, $p > .05$, $r = -.44$. Therefore, the multiple sets of data were averaged for analysis with the remaining data. No significant differences were found between RHR recorded in class and at a competition ($t(4) = -2.46$, $p > .05$, $r = .08$). Figure 3 illustrates the RHR of each dancer from class and competition.

Figure 3. Resting heart rates (b.min$^{-1}$) for each dancer prior to a class and a competition ($n$ = 5).




Further statistical analysis was performed on all mean heart rates recorded during each freestyle-disco and slow dance performance at competition. Results revealed no significant differences in mean heart rates ($n$ = 3) recorded during each freestyle-disco solo performance at a competition ($F_{2, 4}$= 1.27, $p$ >.05). No significant differences were found between warm-ups (M = 187 b.min$^{-1}$, SD = 13.7), semi-finals (M = 192 b.min$^{-1}$, SD = 7.5), and finals (M = 189 b.min$^{-1}$, SD = 8.9), $p$ >.05. Additionally, there were no significant differences found for recorded mean heart rate ($n$ = 4) between slow dance semi-final (M = 188 b.min$^{-1}$, SD = 7.6) and final (M = 186 b.min$^{-1}$, SD = 7.8) performances at a competition ($t$(3) = 1.17, $p$ >.05, $r$ = .93). These results allow for calculation of a reliable average mean heart rate to be used to compare with mean heart rates recorded in class. Table 2 illustrates the results of this comparison between mean heart rates in freestyle-disco solo and slow dance performances in class and competition ($n$ = 4). Overall, analysis found no significant differences in recorded mean heart rates between class and competition performances in both styles ($F_{3, 9}$= 3.36, $p$ >.05). Specifically, no significant differences were found between performance of freestyle-disco solo in class (M = 195, SD = 6.4) and performance (M = 187, SD = 8.8), $p$ >.05.

Additionally, no significant differences were found between slow dance performances in class (M = 183, SD = 11.5) and competition (M = 188, SD = 7.5), $p > .05$.

Table 2. Mean heart rate (b.min$^{-1}$) ± SD for freestyle-disco and slow dance performances in class compared with competition ($n = 4$)

| | Freestyle-Disco | Slow Dance |
|---|---|---|
| Class | 195 ± 6.4 | 183 ± 11.5 |
| Competition | 187 ± 8.8 | 188 ± 7.5 |

Similarly, for maximum heart rate recordings ($n = 3$), no significant differences were found between performances of freestyle-disco at a competition ($F_{2, 4} = 1.97$, $p > .05$). No significant differences were found between warm-ups (M = 196 b.min$^{-1}$, SD = 5.2), semi-finals (M = 199 b.min$^{-1}$, SD = 2.5), and finals (M = 196 b.min$^{-1}$, SD = 4), $p > .05$. Additionally, there were no significant differences found for recorded maximum heart rate ($n = 4$) between slow dance semi-final (M = 194 b.min$^{-1}$, SD = 6.8) and final (M = 195 b.min$^{-1}$, SD = 6.7) performances at a competition ($t(3) = -.707$, $p > .05$, $r = .91$). These results meant that a calculation of a reliable average maximum heart rate could also be used for comparison with average maximum heart rates recorded in class. Table 3 illustrates the results of this comparison ($n = 4$). Overall, there was a significant difference found in recorded maximum heart rate of freestyle-disco solo and slow dance performances between class and competition ($F_{3, 9} = 4.45$, $p < .05$). However, pairwise comparison information details the only significant difference found was between mean maximum heart rate recorded for solo freestyle-disco during class (M = 203 b.min$^{-1}$, SD = 7.3) and mean maximum heart rate recorded for slow dance performance in competition

(M = 195 b.min$^{-1}$, SD = 7.1), $p$ <.05. For all other conditions, no significant differences were reported, $p$ >.05. Importantly, no significant differences were found between freestyle-disco performance in class (M = 203 b.min$^{-1}$, SD = 7.3) and freestyle-disco performance in competition (M = 196 b.min$^{-1}$, SD = 3.3), $p$ >.05. Additionally, no significant differences were found between slow dance performance in class (M = 195 b.min$^{-1}$, SD = 10.9) and in competition (M = 195 b.min$^{-1}$, SD = 7.1).

Table 3. Maximum heart rate (b.min$^{-1}$) ± SD for freestyle-disco and slow dance performances in class compared with competition ($n$ = 4)

| | Freestyle-Disco | Slow Dance |
|---|---|---|
| Class | 203 ± 7.3* | 195 ± 10.9 |
| Competition | 196 ± 3.3 | 195 ± 7.1* |

*Significant difference found between F-D class and slow competition ($p$ <.05)

***Ratings of perceived exertion***

Ratings of perceived exertion (RPE) were collected from each dancer in attendance after each performance of freestyle-disco solo and slow dance performances in competition and during class. These values were tested for any significant differences, so that any average values could be used for comparison of class and competition reliably. The results of this analysis show that there were no significant differences in recorded RPE for solo freestyle-disco performances ($n$ = 3) at a competition ($F_{2, 4}$= 2.71, $p$ >.05). There were no significant differences between any of the rounds of warm-ups (M = 14, SD = 2.1), semi-finals (M = 15, SD = 2.1), and finals (M = 15, SD = 0.6), $p$ >.05. Likewise, no significant differences were found in RPE values ($n$ = 4) recorded during slow dance performances at a competition ($t$(3) = 0.29, $p$ >.05, $r$ = .77). There were no significant differences

between semi-finals (M = 12.5, SD = 2.6) and finals (M = 12.3, SD = 2.4). As with heart rate results, these findings allow for reliable comparison of mean RPE performance values for freestyle-disco solo and slow dance performances between class and competition. Table 4 demonstrates the results of this comparison ($n$ = 4). Overall, there was a significant difference discovered in recorded mean RPE between solo freestyle-disco and slow dance performances in class and competition ($F_{3, 9}$= 4.6, $p$ <.05). However, pairwise comparison information reveals the only significant difference was between mean RPE recorded for solo freestyle-disco performance in competition (M = 15, SD = 1.8) and mean RPE values recorded for slow dance performance during class (M = 13, SD = 2.2), $p$ <.05. For all other conditions, no significant differences were observed, $p$ >.05. Crucially, no significant differences were found between freestyle-disco solo performance during class (M = 14, SD = 1.9) and freestyle-disco solo performance at a competition (M = 15, SD = 1.8), $p$ >.05. Furthermore, no significant differences were found between slow dance performance during class (M = 13, SD = 2.2) and slow dance performance in competition (M = 13, SD = 2.5).

Table 4. Mean ratings of perceived exertion ± SD for freestyle-disco and slow dance performances in class compared with competition ($n$ = 4)

| | Freestyle-Disco | Slow Dance |
|---|---|---|
| Class | 14 ± 1.9 | 13 ± 2.2* |
| Competition | 15 ± 1.8* | 13 ± 2.5 |

*Significant difference found between F-D competition and slow class ($p$ <.05)

***Heart rate v. ratings of perceived exertion***

Pearson's product-moment correlation coefficients were used to investigate the hypothesis of a relationship existing between heart rate and perceived exertion. Average mean and maximum heart rate scores for class and competition for freestyle-disco and slow dance were compared with related average RPE scores. Results for the assessment of a relationship between freestyle-disco solo average mean heart rate values and respective average RPE scores found no correlation between the two variables ($r$ = .053, $n$ = 8, $p$ >.05). Similarly, there was no correlation between average maximum heart rate values recorded for solo freestyle-disco performance and respective average RPE scores ($r$ = -.002, $n$ = 8, $p$ >.05). Additionally, following assessments of relationships between average mean and maximum heart rates, and average RPE scores for slow dance during class and competition, there were no correlations between either of these variables. There was no correlation between average mean heart rate recordings and respective average RPE scores for slow dance performance in class and competition ($r$ = .069, $n$ = 8, $p$ >.05). There was also no correlation between average maximum heart rate values and respective average RPE scores for slow dance performance in class and competition ($r$ = .063, $n$ = 8, $p$ >.05). These results can be visualised in scatterplot graphs in Figures 4-7. Overall, there was no correlation between heart rate and RPE, rejecting the original hypothesis.

Figure 4. Correlational analysis of average mean heart rate values and respective RPE scores in freestyle-disco performances ($n$ = 8)

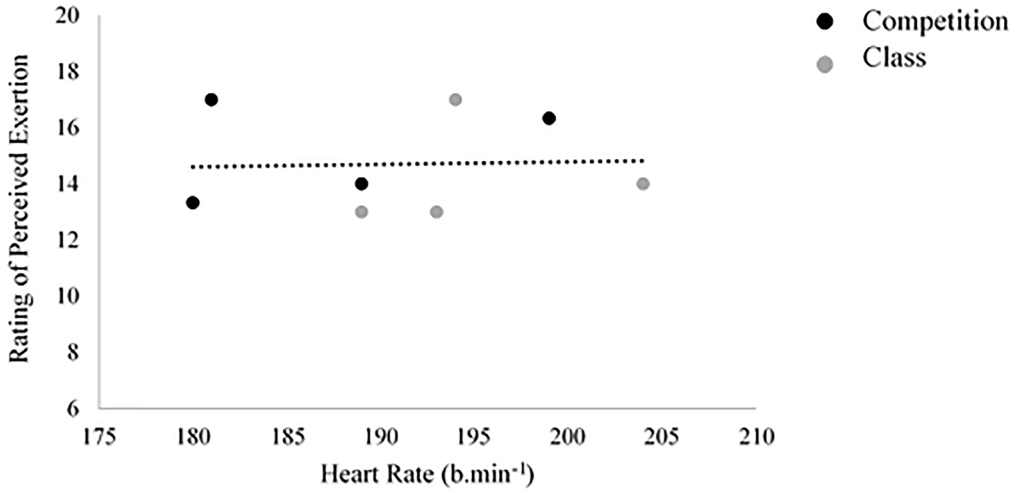



Figure 5. Correlational analysis of maximum mean heart rate values and respective RPE scores in freestyle-disco performances ($n$ = 8)

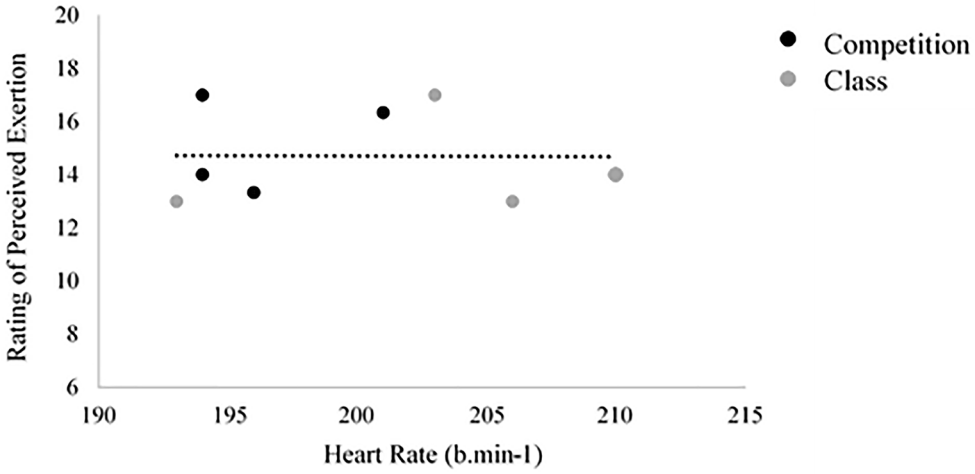


Figure 6. Correlational analysis of average mean heart rate values and respective RPE scores in slow dance performances ($n$ = 8)

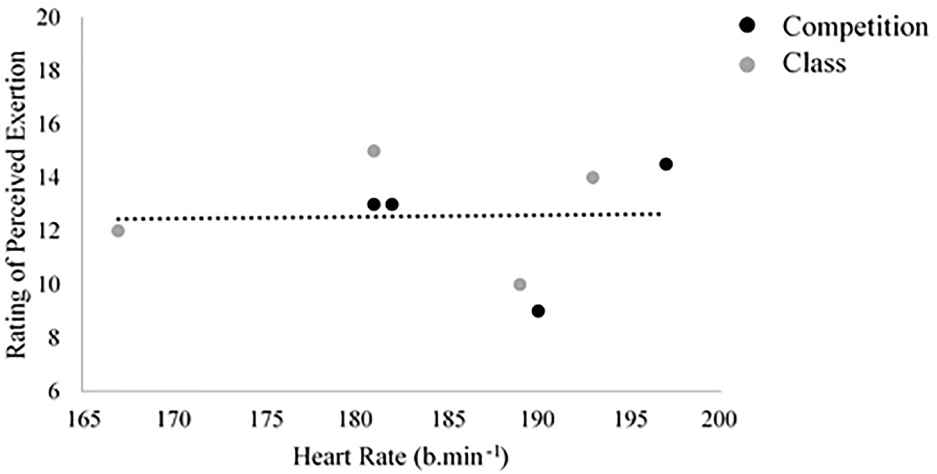
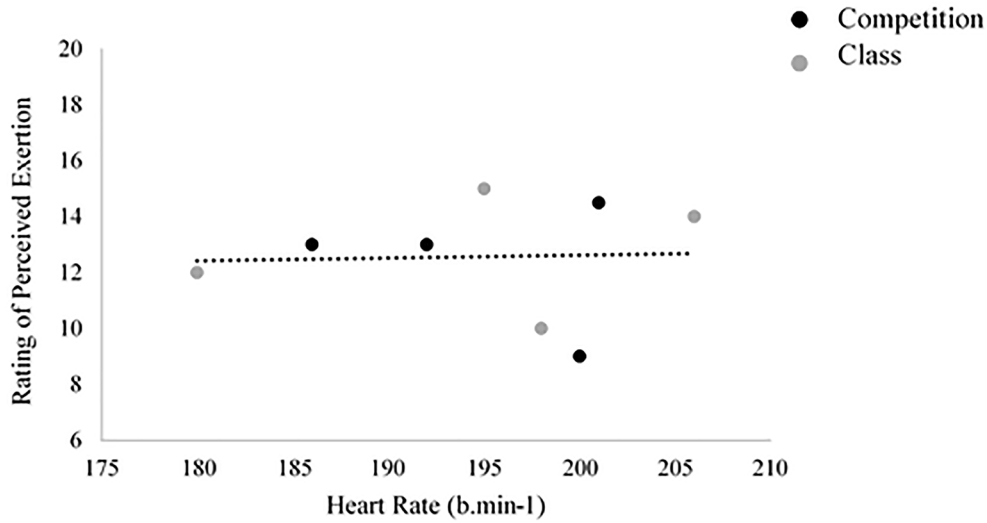



Figure 7. Correlational analysis of maximum mean heart rate values and respective RPE scores in slow dance performances ($n$ = 8)



## Discussion

It was the objective of this project to instigate research into an under-researched dance style. Exploring fundamental physiological characteristics of freestyle-disco dance provided initial findings for future scientific research to emerge from. Early dance science research focused a lot on describing how damaging dance was and creating injury prevention strategies. While this is incredibly important for dancers, like athletes, it is also imperative to gain a clear understanding of the specific demands of each individual dance style and technique in order to provide a solid and positive base of research to start from. This in turn will not only enhance safety measures, but also enable the discovery of optimum ways to improve performance that are specific to each form of dance. This is especially important in an amateur style such as freestyle-disco which characteristically involves very young dancers and is highly competitive. As a starting-point, the specific aims of this research were therefore to investigate heart rate and perceived exertion in freestyle-disco dancers, and subsequently discover whether there were any differences in recordings when comparing class and competition. The research also aimed to assess whether there was a relationship between recorded heart rates and perceived exertion of participants.

### *Heart rate*

The resting heart rates (RHR) recorded in this study appear to be somewhat high considering the amount of physical activity reportedly undertaken by the dancers. Especially considering previous research in normal-weight adolescent girls has reported average RHR of 86.9 $b.min^{-1}$ (Kwok, et al. 2013) and 77.4 $b.min^{-1}$ (Sarganas, et al. 2017), and a negative association between RHR and exercise frequency; indicating an expectation for active adolescents to have lower RHR. An explanation for the high RHR of the dancers in this study could be related to lower cardiorespiratory fitness (Fernandes,

et al. 2013). Another causation could be that dancers were not fully at rest when RHR were recorded. Heart rates were recorded on arrival to class and competition, where there was not enough time to control for variables such as getting ready, warming up and playing around. Performance anxiety and heat are often thought to raise RHR. However, as there were no significant differences found between RHR prior to class and competition, this assumption cannot be made in this case.

No significant differences were found between recorded mean heart rates and maximum heart rates in all competition performances of solo freestyle-disco and slow dance. This could indicate that dancers are all trained to a similar level, experiencing similar training adaptations, regardless of being at different age-related developmental stages. Wyon et al. (2002) also found no significant differences between their participants' mean heart rate values. Although participants were of similar ages, they were at different levels of their dance careers which could support the idea of similar training adaptations. The results also show consistency between performances, opposing results found by Liiv et al. (2014) where highest heart rates were being recorded during the last rounds of a 'DanceSport' competition. The contradiction with the results in the freestyle-disco dancers could be explained by differing work:rest ratios in competition. In DanceSport, couples must complete all dances back-to-back with around 20 seconds rest between each (Liiv, et al. 2014). Whereas freestyle-disco dancers have larger rest periods of anything between 2 minutes and 3 hours between performances. Consequently, freestyle-disco dancers were found to generally be commencing performances from resting heart rates, where DanceSport dancers were performing each dance at already high heart rates. This might turn out to be the case for championship freestyle-disco dancers who, if in the final, would have to complete a 'solo-spot' and have between 20 seconds and 2 minutes to recover (depending where in the sequence dancers perform) before

dancing a final round all together. There were no championship dancers in this study to support this theory, but it would be an interesting investigation for future research.

The warm-up elicited similar heart rates to dance phases of over 85% $HR_{max}$, contradicting findings from other research that found significant differences between the phases. In studies of ballet, warm-ups were found to consist of small movements at a low intensity of around 60% $HR_{max}$ and centre phases consisted of travelling movements at higher intensities of around 75% $HR_{max}$ (Cohen, et al. 1982; Schantz and Astrand 1984). The difference in activities performed within each class phase elicit differing results in freestyle-disco, where warm-ups tend to be more dynamic and consisting of aerobic activity than in a traditional ballet class warm-up.

No significant differences in mean and maximum heart rate recordings were found between class and competition. These results dispute the results of the research by Baillie et al. (2007) on which this research was based. These authors found mean heart rates of 152 $b.min^{-1}$ in class but near maximal rates in competition, arguing that class does not prepare highland dancers for competition. Although, it is not clear whether the mean heart rate was an average for the whole class. The class could involve sections of differing intensities and when averaged would not accurately reflect the variation. To have calculated a mean value for heart rate to cover the whole class for freestyle-disco would not be useful for analysis as the class was so varied, with recordings from resting to near-maximal. Other studies in ballet (Schantz and Astrand 1984) and contemporary dance (Wyon, et al. 2004) have also reported mismatched intensities between class and competition. Authors claim that class does not reach intensities of competition or be sustained for long enough to prepare dancers for performance. However, the intermittent nature of class appears to be suitable for preparing dancers for freestyle-disco competitions, as they are intermittent and heart rate recordings were similar in both class

and competition. Yet, it could be argued that class did not prepare dancers fully as performances in class were not sustained for the same amount of time as a round in competition.

Some of the authors explain a possible cause of the differences found between class and competition in Highland dance to be due to psychological arousal and competition anxiety (Baillie, et al. 2007; Schantz and Astrand 1984). Adrenaline release caused by pre-competition or pre-performance anxiety can result in an increase in pre-competition heart rate. Baillie and colleagues (2007) however, explain that highland dance is a high intensity dance style that requires a high cardiac output and concluded that physiological drive is more likely to cause high heart rates than any effects of psychological arousal. This is echoed by Schantz and Astrand (1984) who theorised a similar possibility. But an investigation into this possibility, where participants performed the same dance piece with and without an audience, resulted in no significant difference between the two (Schantz and Astrand 1984). Rehearsal heart rates averaged only 5-10 $b.min^{-1}$ lower than during the actual performance. As no significant differences were found for resting, mean and maximum heart rates between class and competition in freestyle-disco, it could be assumed that there was no psychological effect of competition on results of this research. This should, however, be investigated further with a larger sample as there are many factors that could have affected heart rate that were not controlled such as the heat of the competition venues and activities prior to RHR measurements in both class and competition.

***Ratings of perceived exertion***

There were no significant differences in RPE scores for freestyle-disco and slow dance performances between class and competition. Although not significant, dancers tended to report higher perceived exertion in competition compared to class. Although RPE is often

regarded as a valid method in research, some scales have been found to be difficult for children and adolescents to interpret (Lagally 2013). This could explain the mixed results in this study. While the scale and what was required of the participants was explained in detail, younger dancers may not be psychologically mature or self-aware enough to give accurate perceptions of their own exertion. Equally, it could be understood, on the premise of accurate reporting, dancers may have, in fact, not felt any greater exertion in competition as they may actually feel they are using the same amount of physiological drive each round. In order to understand this, it may be worthwhile asking dancers to give a short explanation of why they chose a certain rating and how they feel.

Possibly due to the competitive nature of freestyle-disco, dancers are often reprimanded by teachers for not putting enough effort in. Thus, response bias could have had an impact on results as they may have wanted to impress or please the researcher with either how much or little exertion they perceived. Older dancers followed a similar pattern, scoring slightly higher for finals than warm-up round. This may be what they truly perceived or they may have a better understanding of what they expect results should be.

***Heart rate vs. perceived exertion***

There were no significant relationships between mean and maximum heart rate recordings and RPE for freestyle-disco and slow dance performances in class and competition. This counters Borg's widely accepted work (1970) claiming that there is a general linear relationship between heart rate and perceived exertion, and that humans are able to subjectively recognise different exercise intensities. Results from a study on an aerobic dance programme for college-age women are consistent with this theory; finding that following the programme, a decrease in submaximal heart rate corresponded with a decrease in submaximal RPE (Rockefeller and Burke 1979). However, another study in

aerobic dance found opposing results, and therefore is consistent with the results of this study, discovering no significant correlation between heart rate and RPE (Schaeffer-Gerschutz, Darby and Browder 2000). However, they did find a significant relationship between RPE and respiratory phenomena, signifying a possibility for correlation with Borg's work.

***Limitations***

This study had a very small sample size. This was to be expected in a new research area where dancers of this style may not have experience of taking part in research and may be very hesitant to respond to attempts of recruitment. A small sample size makes conclusions problematic and therefore generalisations cannot be made from the results found. This small sample has, however, allowed for exploration of the methodological limitations of this research and how these can affect results and respective analysis. Only one participant was able to do all four sessions and the equipment failed. In this case it would have been useful to pilot test the protocol and equipment. However, this was not possible due to time constraints. Additionally, a larger sample size would allow for potential technological failures and participant absences.

Heart rate and perceived exertion as physiological measures also come with limitations. It is well documented that heart rate is affected by anxiety and heat and it would therefore be assumed that these factors would have some effect on these competitive dancers. Our findings have shown no differences in heart rate measures between class and competitive performance; however, it is acknowledged that there were factors prior to measurement that were unaccounted for at the time that may explain this. Again, a larger sample size and a more controlled protocol would be needed to make any sort of comparison or conclusion of our initial results. Additionally, perceived exertion is a subjective measure and even though it is commonly used throughout sport science

research, it is not always reliable and as previously discussed, can be more problematic when used with young participants.

Although ecological validity is good for this research it comes with some important limitations. Firstly, it was not possible to control competition environments. Both were warm summer days, outside temperatures around 21˚c, but the conditions inside the sports halls were very different. The temperature in one was controlled with air conditioning and the other was not, creating a very warm and uncomfortable environment. Heat has been found to affect heart rate and thus these conditions could have affected the results. Results between competitions were not significantly different so it might be assumed that environmental conditions did not have an effect in this case, but it is not possible to make these assumptions based on a small sample and only comparing two competition environments. Secondly, it was not possible to collect data in classes the same side of a competition due to summer class scheduling. One of classes tested was the day before a competition and the other class tested was the day after a competition. Dancers are likely to be more fatigued the day after a competition and this may have affected the results.

**Conclusion**

The purpose of this research was to initiate research in freestyle-disco dance and illustrate the necessity for further research in this style. The main research aim was to investigate some fundamental physiological characteristics, in this case, heart rate and ratings of perceived exertion in class and competition. This enabled a new researcher to explore methodological considerations for young dancers in a competitive environment and discover practical and technological issues associated with research.

Substantial methodological limitations, mostly due to time and resource constraints, and a small sample size mean that it is not possible to make any conclusions

from the results found in this study. It is possible, however, to utilise this research as a base for a larger-scale piece of research with a suitably adapted methodology and for learning more about this exciting dance genre and its incredible athletes.

***Recommendations***

Further work needs to be specific to a dance style, as it is clear that although there may be similarities between dance styles, there are fundamental differences which inhibit generalisation of results to dance as a collective. Future work is required in freestyle-disco as the style is growing more popular each year and becoming more complex. Although the A.D.F.P. continually revise the rules and safety regulations, freestyle-disco would benefit from further research into training methods that allow safe performance of interesting and complex movements, that make the style as exciting as it is. In order to identify the most effective training methods, further research into the physiological characteristics of freestyle-disco and demands placed on dancers is needed. Research should include a large sample of dancers from a variety of different schools, to get a better idea of the demands. Additionally, it would be useful to test the validity of using RPE scales for children and adolescents. It would also be interesting to compare different levels of dancers, for example championship dancers against beginners/starters to investigate if there are differences in physiological demands in these dancers.

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