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This is an accepted manuscript of the article published by Taylor & Francis in *International Journal of Performance Analysis in Sport* on 19 Nov 2020, available at <https://doi.org/10.1080/24748668.2020.1847936>

Citation for published version:

A. Gutiérrez-Santiago, A. Pérez-Portela & I. Prieto-Lage (2021) Analysis of the internal logic of breaking using temporal and sequential parameters, *International Journal of Performance Analysis in Sport*, 21:1, 90-107, DOI: [10.1080/24748668.2020.1847936](https://doi.org/10.1080/24748668.2020.1847936)

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# **Analysis of the Internal Logic of Breaking Using Temporal and Sequential Parameters**

**Running head: Time-motion in breaking**

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Word count: 5450

Abstract word count: 200; number of tables: 7; number of figures: 2

## **Analysis of the Internal Logic of Breaking Using Temporal and Sequential Parameters**

Quantifying the effort of a sport confrontation by determining its temporal structure concerns the scientific community. It has not yet been studied in breaking. The objective was to determine the temporal and sequential structure of men and women breakers. All of the men and women dancers participated in Red Bull BC One 2018 and 2019 (32 women and 32 men). Through observational methodology, we analyzed all of the battles (n=60). In order to obtain the results, we utilized different analytical techniques: descriptive, One-Factor ANOVA, independent samples t-test, effect size and T-Patterns analysis. The level of significance established for the study was  $\rho \leq 0.05$ . The results defined a temporal and sequential structure of the battles of the men and women. Using these results, the breaking professionals would be able to develop precise and adequate trainings for these athletes. We concluded that there are clear differences between the B-Boys' and B-Girls' battles. The men have longer battles, and they use explosive and dynamic movement patterns (Power Move) that lead to shorter and more intense rounds. The women have longer rounds, using patterns with artistic and rhythmic movements (Footwork, Top Rock and Freeze) that lead to less intense outputs, but nevertheless, longer.

Key words: breaking; time motion; gender, dance, Hip-Hop

## **1. Introduction**

The effort made by athletes is determined by the internal logic of the sport itself. There are sports where efforts are continuous (cycling, swimming, canoeing, etc.) and sports where the effort is intermittent (football, judo, boxing, etc.). The intermittent efforts are determined by regulation, establishing obligatory pauses with a set duration (i.e. football or boxing). In other cases, despite the fact that there is no regulatory rest, there are intermittent pauses where their duration is undetermined because they are established by the technical-tactical actions that the athletes develop during the match (i.e. judo). In other disciplines (like breaking), the rest times (of an undetermined duration) are established by the athletes' alternating participation throughout the development of the competition. This way, while an artist intervenes (making an effort) the other rests, as their roles are exchanging.

There are many sports where the efforts are intermittent. The actions of the athletes are interspersed with pauses. The duration of these efforts and pauses are variable. All of this defines a different temporal structure for each sport discipline. Because of this, it is important to study the temporal structure, since it conditions the effort to be made and determines the most appropriate training load for each athlete (Gutiérrez-Santiago, Gutiérrez, & Prieto-Lage, 2020).

For this reason, the scientific community has been concerned with quantifying the effort of a sporting match by determining its temporal structure (Andreato, Follmer, Celidonio, & Honorato, 2016; dos Santos et al., 2019), since this defines the type of force required and its distribution (time of effort/pause). These types of investigations have been carried out in a multitude of sports disciplines (i.e., Deutsch, Kearney, & Rehrer, 2007; Spencer et al., 2004; Wyon et al., 2011).

Despite the efforts made by the scientific community, there are still disciplines that urgently need this type of research, as is the case of breakdance (also called breaking).

Breaking is an urban dance that forms a part of the Hip-Hop culture. As in other dances, there are stereotypes and prejudices that associate breakdance with a single gender (Langnes & Fasting, 2014). Although it is true that there are predominantly more men practicing this discipline, there are less and less differences and this social barrier is broken even more (Langnes & Fasting, 2017).

Recently, breaking has been selected as a discipline for the Olympics that will be celebrated in Paris in the 2024 Olympic Games (Li & Vexler, 2019). This has been a great milestone in the process of making this sport that began on the streets of the Bronx, one of the most impoverished neighborhoods in the United States. Undoubtedly, this humble origin could explain why the scientific literature on this discipline is limited. Basically, there are studies on epidemiology and injury prevention (Cho et al., 2009; Russell, 2013), physiological aspects (Wyon et al., 2018), creativity development and motor skill acquisition (Shimizu & Okada, 2018) and sociological aspects (Langnes & Fasting, 2014, 2017). Despite its global exponential growth, being a future Olympic sport, we still do not have specific studies on effort from a time-motion perspective.

To solve this lack of study, we propose a study of which the objective is to determine the temporal and sequential structure of breaking in women and men, establishing the existing differences between both genders. The results of this research will determine the effort made by these athletes and will help the coaches, sports technicians and athletes themselves to establish the load of their workouts more appropriately and individually for each gender.

## **2. Method**

### **2.1. Design**

The observation methodology allows the spontaneous perceptible behaviors in their natural environment to be analyzed (Anguera, Blanco-Villaseñor, Losada, & Portell, 2018). For this reason, we have used observation methodology in order to detect a temporal and sequential pattern of the B-Boy and B-Girl dancers in breaking.

The observational design (Anguera, Blanco-Villaseñor, Hernández-Mendo, & Losada, 2011) that was used was nomothetic (all of the battles/rounds), intrasessional and intersessional follow-up (all of the behaviors in the battle throughout the entire championship were analyzed), and unidimensional (we only analyzed one level of response). Through this design, a series of decisions about the participants, the observational and recording instruments and the analysis procedure were derived.

### **2.2. Participants**

All of the B-Boys and B-Girls from Red Bull BC One 2018 and 2019 participated, 2018 being the first year in which there was a female modality. In total, there were 64 subjects (n=32 B-Boys, n=32 B-Girls). Given that the analysis unit of this study is the battle, a total of 60 battles were analyzed (n=60, 30 of each gender). The study was approved by the Ethics Committee of the Faculty of Education and Sport Science (University of Vigo, Application 02/0320).

### **2.3. Instruments**

The observational instrument for this study was made *ad hoc*. The instrument described in Table 1 is a comprehensive system of mutually exclusive categories (Camerino, Camerino,

Prat, Jonsson, & Castañer, 2020) called Observed Temporal System for Breaking -OTSB. The validity of the construct of the observation instrument was done by its coherence with the theoretical framework (González-Prado, Iglesias, & Anguera, 2015) and by consulting two breaking experts that reached a degree of agreement of 95% in response to a questionnaire about the observation instrument, analyzing the suitability of it for the reality of the competition and by following the same procedure as previous studies (Prieto-Lage, Louzao-Neira, Argibay-González, & Gutiérrez-Santiago, 2020). The two experts were provided with a comprehensive description of the observation instrument, the objects of the investigation and instructions for answering the questionnaire. The questionnaire consisted of five items (with a Likert scale of five levels) about its suitability to the object of study, compliance with the criteria of completeness and mutual exclusivity, clarity in the wording of the categories and the degree of objectivity that allows the data collection to be unified by various observers.

The data was recorded with LINCE v.1.4 software (Gabin, Camerino, Anguera, & Castañer, 2012).

\*\*\*Table 1 near hear\*\*\*

#### ***2.4. Procedure***

It was not necessary to get informed consent from the participants because the videos of the battles were obtained through a secondary source (from the official Red Bull BC One YouTube channel), and the information was not generated through experimentation (American Psychological Association, 2002).

After an adequate instrument-use training, two expert observers in breaking and in observation methodology recorded the battle data with LINCE v.1.4 software. To guarantee the strictness of the recording process (Blanco-Villaseñor & Anguera, 2000), the quality of

the recorded data was controlled by calculating intra and inter-observer agreement by using Cohen's kappa coefficient (Cohen, 1968) calculated by LINCE software. In both cases (agreement between the intra and inter-observer) the calculation of the kappa coefficient was applied to all of the categorical variables of the observation instrument, obtaining all of their mean values. Both agreements were made with battles that did not belong to the final sample, in a number that was equivalent to a third of the final sample (n=20). The first agreement was made with the intraobserver that obtained an average kappa value 0.97 of all of the categories in Observer 1 and a value of 0.95 in Observer 2. Later on, the agreement of the interobserver was calculated by obtaining an average kappa value of 0.90 in all of the categories.

The men's battles have six rounds (three per dancer), and the women have four rounds (two per dancer, except for the final, that has three rounds). Each athlete was studied individually by recording the movements that they executed and their duration.

After recording all of the battles, the data was exported with LINCE software to an Excel file and also to a file to use with THEME software with the sequentiality and temporality of all of the study behaviors. These files allowed us to conduct the different analyses (Gutierrez-Santiago, Prieto, Camerino, & Anguera, 2011).

## **2.5. Data Analysis**

All of the statistical analyses were made by using IBM- Statistical Package for the Social Sciences, version 20.0 (IBM-SPSS Inc., Chicago, IL, USA). A general descriptive analysis was carried out as well as other analyses stratified by sex, by phase of the competition, and by the rounds of the battle of each one of the variables that were studied, through measures of central tendency (average and typical deviation). Kolmogorov-Smirnov's test confirmed the normality of the sample. To determine the existence of the differences between men and women, an independent samples t-test was conducted. To detect differences between the



different phases of the competition (eighths, quarters, semifinal and final) and between the different rounds (rounds one and six), ANOVA was used as a factor, applying the Tukey-b test post hoc in case statistically significant differences existed. A  $p < 0.05$  level of significance was considered. We analyzed the effect size through Cohen's  $d$  (Cohen, 1988).

The exact sequentiality of the behaviours of the athletes was established through a T-Patterns analysis with Theme v.5.0. (Magnusson, 1996, 2000). We used search parameters that were similar to other studies (Amatria, Lapresa, Arana, Anguera, & Jonsson, 2017; Lapresa, Del Río, Arana, Amatria, & Anguera, 2018). Specifically: a) frequency of occurrence of  $\geq 3$ , b) significance level of 0.005, c) redundancy reduction setting of 90%, d) deactivation of fast requirement at all levels and selection of free heuristic critical interval setting, e) deactivation of simulation filter. This software reveals hidden structures and aspects of unobservable behavior (Casarrubea & Di Giovanni, 2020), and its application is extremely effective in sports science (Casarrubea & Di Giovanni, 2020; Gutiérrez-Santiago, Pereira-Rodríguez, & Prieto-Lage, 2020; Prieto-Lage, Louzao-Neira, et al., 2020; Prieto-Lage, Rodríguez-Souto, Prieto, & Gutiérrez-Santiago, 2020).

Subsequently, we applied a qualitative criterion (Amatria et al., 2017) that helped us select the patterns. The patterns had to respond to the sequential logic of a round, beginning with the behaviors that could have only happened while standing (Top Rock). We selected the patterns that respected the results obtained in the descriptive data that was calculated with SPSS (average values of the Global Sequential Parameters). Regarding the predetermined quantitative criteria through Theme (occurrences, length and duration), we have selected patterns with an occurrence of  $\geq 3$ ; neither a maximum nor a minimum has been established for the length, and the duration was calculated with SPSS.

### **3. Results**

#### ***3.1. Global Analysis and by Gender of the Battles***

Table 2 presents a global analysis of the battle and by the gender of the study carried out.

Significant differences were observed ( $p < 0.05$ ) between both genders in the temporary global parameters with the men using more time to do the Power Move, Acrobatics and Link. We detected significant differences between genders in the sequential parameters of the battle, the men being those that incorporated more elements, especially Footwork, Power Move, Acrobatics and Link. These differences disappeared in the partially temporal parameters, and the only differences were in Freeze, being higher in women.

\*\*\*Table 2\*\*\*

#### ***3.2. Analysis of the battles in the different phases of the competition***

The analysis of the sequential and temporary parameters of the battles depending on the time of the competition reflected that there were not any significant differences ( $p > 0.05$ ) between the distinct phases (eighths, quarters, semifinal and final) in the men's competition. In the women's competition, there were significant differences ( $p < 0.05$ ). We highlight that the total time of the battle was clearly higher in the finals, reflecting in the Turkey-b test post hoc that the finals showed significant differences with the rest of the phases of competition ( $F = 3.208$ ;  $gl = 3$ ;  $p = 0.039$ ). The Footwork time during a women's battle was significantly different between the distinct phases, showing the Turkey-b test post hoc that more time was dedicated to this behavior in the final than in the rest of the other phases ( $F = 4.192$ ;  $gl = 3$ ;  $p = 0.015$ ); specifically, as the competition progressed, more time was dedicated to this behavior.

Table 3 shows a comparison by gender of the sequential and temporary parameters of the breaking battles in each of the phases of the competition. We highlight that as the competition progresses, the differences between the men and women are very few, so much so that there are no significant differences in the finals.

\*\*\*Table 3\*\*\*

In the round of 16, we observed that in the total time of the battle, the total time of Freeze and Power Move were significantly higher in the men. Additionally, all of the sequential parameters of the battle were significantly higher in the men. The situation of the duration of an element was reversed in the partial temporal parameters, and Top Rock and Footwork were significantly higher in women.

Total time of Power Move in quarterfinals, total number of elements, Top Rock number, Footwork and Power Move were significantly higher in men. The partial duration of Footwork was significantly higher in women. In the semifinals, there were not any significant differences in the temporal parameters (neither in global nor in partial), except for the number of elements carried out and in the number of Power Moves that was higher in men.

### ***3.3. Analysis of the different battle rounds***

Table 4 presents a description of the temporal and sequential parameters of each one of the battle rounds, and it also contains a comparison between them in the men's competition. The length of Round 1 was significantly higher than the other rounds, their duration being less as the battle progressed. The aforementioned circumstance happened all the same in the number of elements that were carried out in the battle, and they were significantly higher in Round 1. We also obtained significant differences in the partial duration of Acrobatics, the stunts of the first round being the shortest and the stunts of the last round being the longest.

\*\*\*Table 4\*\*\*

Table 5 shows a description of the temporal and sequential parameters in each one of the rounds of the battle, and a comparison between them in the women. When we compared the six rounds in female competition to each other (a circumstance that only happens in the finals), we observed that there were not any significant differences in any of the parameters that were studied. If we reduce the comparison to the first four rounds (a way of competing in rounds of 16, quarters and semifinals), there would be significant differences in the duration of the round, the first round being the longest. The duration of the rounds decreased as the battle progressed

\*\*\*Table 5\*\*\*

Table 6 presents a comparison between men and women from the sequential and temporal parameters in each one of the rounds. The total duration of Rounds 2, 3, 4 and 6 were significantly higher in women. The total time of Top Rock and Footwork in Rounds 1, 2, 3, and 4 were significantly higher in the women.

\*\*\*Table 6\*\*\*

The total number of elements and the total quantity of Footwork and Power Move in Round 1 was significantly higher in men, while in Round 6, the men stood out for performing more Top Rock than the women.

Finally, the partial duration of an element was significantly higher in women in Rounds 1, 2, and 4. The partial duration of Top Rock in Rounds 1, 2 and 6 was clearly higher in the women. The partial duration of Footwork in Rounds 1, 2, 4 and 6 was significantly higher in women. There was also a significant difference in the partial length of Freeze in the sixth round that was higher in women.

### ***3.4. Detection of the temporal patterns (T-Patterns)***

The analysis of T-Patterns indicates the exact distribution of the sequential parameters of the battles. Figure 1 shows this distribution in each of the rounds in the women's competition, and Figure 2 shows the men's competition.

\*\*\*Figure 1 and 2\*\*\*

## **4. Discussion**

### ***4.1. Discussion about the results***

In the breakdance championships analyzed, we have compared the men and the women. The ordination and duration of the confrontations is not equal between men and women. The structure of the competition has three rounds in each battle for the men and two rounds per battle for the women (except for the final that also has three rounds). The organization of the tournament allows the women to have a day off (between the quarterfinals and semifinals), while the men compete on the same day. It is important to consider these aspects throughout the discussion, since the fatigue and the energetic management of the tournament will not be the same in both genders.

Regarding the results obtained, we would like to highlight that men spend more time doing Power Moves and Acrobatics. These actions demand a lot of explosiveness, dynamic strength and muscular power, especially the upper body (Wyon et al., 2018).

We would also highlight that men use more elements per battle, probably due to the fact that they have more rounds. The men carry out a high number of Power Moves due to their high capacity of response before explosive performances (Wyon et al., 2018).

The partial duration of the Freeze is higher in women. The Freeze move demands a lot of control, balance and flexibility. The women use these actions for a longer time because they adapt better to positions that demand flexibility, possibly due to hormones such as estrogen and a smaller muscular mass that allows greater and more relaxed flexion (Hicks, Kent-Braun, & Ditor, 2001; Mizuno, 2019).

As the competition progressed, there were less significant differences between men and women to the point of not having any in the finals. In the round of 16, we confirm that in the duration of the battle, the total time of the Power Move and Freeze and the sequential parameters are greater in men, due to fact that B-Boys have three rounds per battle, having more time than the women. The partial duration of Footwork and Top Rock is greater in women. Probably, by having fewer rounds, they reserve those acrobatic and explosive movements for the final part of the battle or other battles. To make up for the lack of explosive movements in the initial part of the battle or in the first battles, they use more rhythmic and musical elements (Footwork and Top Rock), those of which demand another type of resistance and cause another type of fatigue, which is an aspect that has been justified in previous research (Wyon et al., 2018).

In the quarterfinal, the total duration of the Power Move is greater in men, involving a greater use of explosive movements and dynamic strength, a circumstance that has been evidenced by Wyon et al. (2018). The men carry out a great number of elements and a higher amount of Top Rock, Footwork and Power Move because they have a greater number of rounds.

In the semifinals, the men perform a great number of elements and the Power Move, confirming that they continue using these types of movements (Wyon et al., 2018). In the

final there are not any significant differences between both genders probably because they have the same number of rounds.

In the men, the duration of the first round is significantly greater than the rest of the rounds. Additionally, the duration of the rounds is less as the battle progresses, probably due to the accumulation of fatigue or even a strategy of saving energy, as it so happens in other sports (Kons, Orssatto, & Detanico, 2020). The number of elements performed in a battle is greater in the first round. This is possibly due to the fact that there is a clear dispute in the first round. Whoever goes first has to make a lot of effort so that the judge remembers them well and to make their rival's response more difficult, trying to overwhelm them with many movements, as a form of intimidation. Finally, we would like to highlight that Acrobatics in the first round are shorter than Acrobatics in the last round, probably due to the fact that the B-Boy wants to end the battle in a forceful way in order to capture the judge's attention.

The first round of the women has the greatest duration, decreasing as the battle progresses, predictably due to the accumulation of fatigue or even the strategy of saving energy just like in other sports (Kons et al., 2020). The greatest duration of the women's rounds could be due to two motives: B-Girls have less rounds than B-Boys, they use rhythmic elements (Toprock or Footwork) that demand less use of explosive force, the fatigue being easier to control (Wyon et al., 2018), allowing them to have longer rounds.

The comparison between men and women of each of the rounds reveals that all of the rounds are greater in duration in the women. There are several reasons that would explain this circumstance: women count as having a day of rest and the men have to dose the effort by having one more round. The structure of the male tournament demands the men to perform for a shorter time and to be more direct in their rounds in order to endure both the present and subsequent battles. Research about contemporary dance and ballet (Wyon et al., 2011) affirms

that contemporary dance has long periods of performances that have a mild-moderate intensity with short breaks. Conversely, the performance periods in ballet are shorter, with explosive movements that have an elevated intensity with much longer rests. Without a doubt, there is a clear analogy with the results obtained in men and women in breakdance. The men use more explosive and dynamic force and arrive at peaks that demand oxygen higher than the women (Wyon et al., 2018), making them do shorter rounds to proportion the strength. The women can perform longer rounds because they use techniques that allow better control of energetic demands, as in Top Rock and Footwork.

The men perform a greater number of Top Rock movements in the last round. We consider that the fatigue that is accumulated during the battle obliges the B-Boys to implement movements that demand less energy (Top Rock) in the last round, using them as micro recoveries within the previously stated round.

The partial duration of Footwork and Top Rock is greater in women in all of the rounds, due to the fact that they are rhythmic and musical elements that entail another type of fatigue, that of which is easier to manage, as was proved by Wyon et al. (2018). The partial duration of Freeze is greater in women than in almost all of the rounds, and this is probably because they feel more comfortable in positions that demand high flexibility (Hicks et al., 2001; Hunter, 2009; Mizuno, 2019).

In this study, we have quantified the strength used by the athletes through the determination of the temporal and sequential structure of the breakdance battles. Due to the objective of this investigation, we have not analyzed more subjective aspects, therefore limiting the study. We are aware that a battle is much more than a series of connected movements, influencing the sport artists' biological, psychological and emotional factors (adrenaline, age, pressure, nerves, tiredness, an injury, etc.) that could affect their



performance, all of which are aspects that need to be considered in future studies about breaking.

#### ***4.2. Practical Applications***

The results of this study show clear differences between men and women. This implies that the results cannot be generalized. They have to be individualized by gender. With the results of this study, we can establish a temporal structure “type” of a women and men’s battle considering each one of the rounds (Table 7). Based on the structures, the sports performance professionals would be able to elaborate and develop more precise and accurate trainings.

\*\*\*Table 7\*\*\*

Men perform longer battles and use a greater number of elements in each round. They also use Power Move and Acrobatics more. The men use up more energy because they have one more round and because they use explosive and dynamic patterns that lead into shorter and more intense rounds.

The women perform longer rounds, using patterns with artistic and rhythmic movements (Footwork, Top Rock and Freeze) that depend on the flexibility and aerobic resistance, leading into more intense rounds, but are longer, and being able to control fatigue better. Women have less of an energy output because they have a day of rest and perform fewer rounds.

Footwork is the most used element in both genders, using Footwork at least twice per round, making it the core of breaking. Footwork tends to lead into a Power Move or Freeze. Top Rock is the element that is most used to start a round; however, it is what least leads into Links, which normally triggers Power Move, Footwork or Freeze. After a Power Move, Footwork or Freeze usually follows, and after Freeze, the movements usually pass to Power

Move or Footwork. The most repeated patterns are [Toprock–Power Move–Footwork–Freeze] and [Toprock–Footwork–Power Move–Freeze] with Freeze at the end of the round.

## 5. Disclosure statement

The authors report no conflict of interest.

## 6. Acknowledgements

The authors would like to thank all of the breaking professionals (artists, judges and trainers) that collaborated in this study. We highlight to Richie “Abstrak” Soto (Florida, United States), Graciél Stenio (Madrid, Spain), Poe One (Adelaide, Australia), Dyzee (Toronto, Canada), Samuel Revell “Coach Sambo” (Amberes, Belgium).

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FIGURES

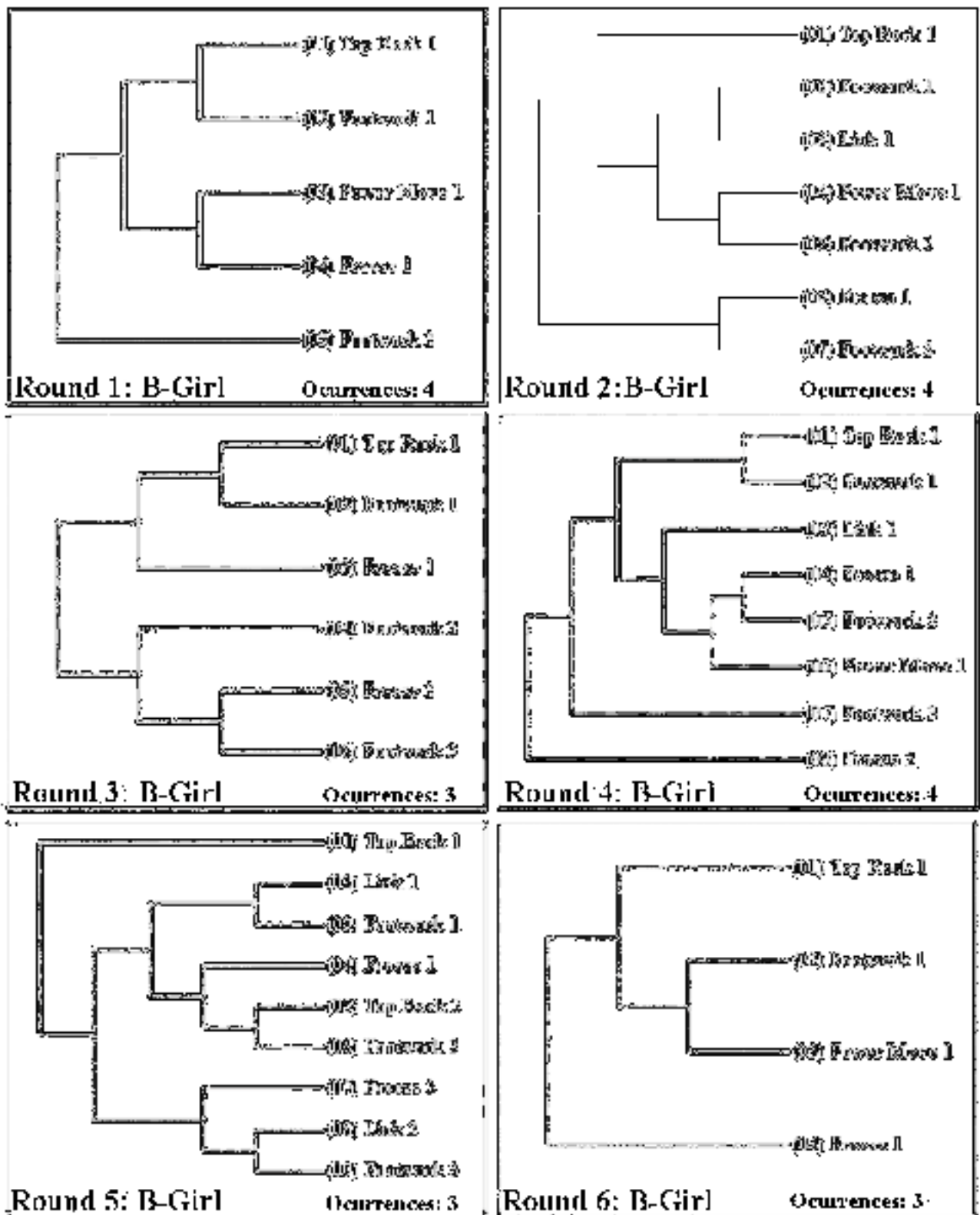


Figure 1. Sequential patterns of *breaking* behaviors in the women's six rounds.

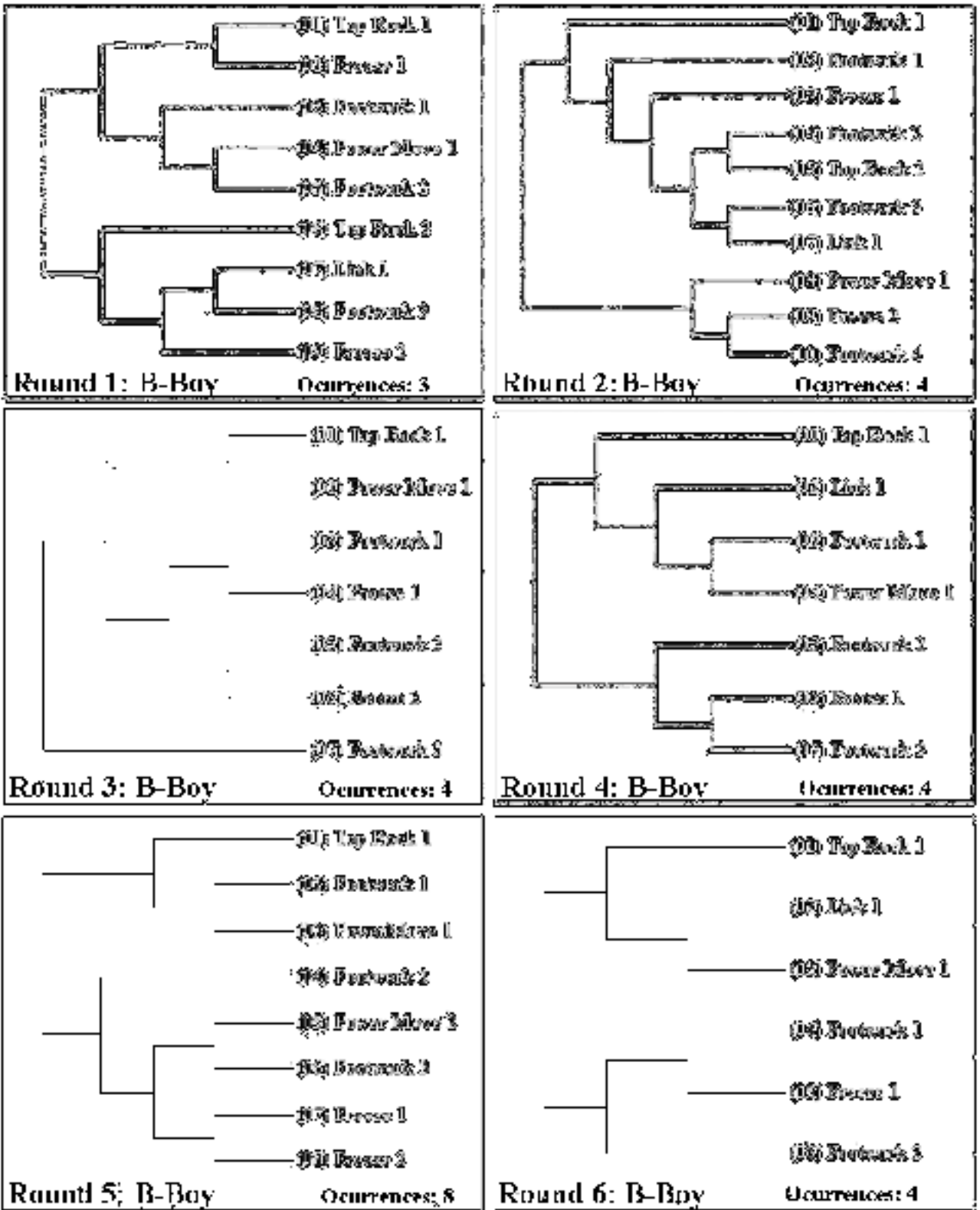


Figure 2. Sequential patterns of breaking behaviours in the men's six rounds.

**Table 1.** Observational Instrument.

<b>Category</b>	<b>Code</b>	<b>Description</b>
<b>TOP ROCK</b>	<b>TR</b>	It includes any movement made standing up in order to follow the rhythm of the music or the “beats” that the song marks.
<b>FOOTWORK</b>	<b>FW</b>	Movements made on the floor with different body supports, which can go to the rhythm or not and that has multiple levels or scales.
<b>FREEZE</b>	<b>FR</b>	Movements that execute a stop or a "stop" at the exit of the dancer, whose posture is well defined and maintained in a short period of time.
<b>POWER MOVE</b>	<b>PM</b>	Dynamic equilibrium explosive movements with more than one axis of action (sagittal, longitudinal and transverse). All those movements of 3, 2 or 1 supports with the possibility of aerial phase and return while on the move.
<b>ACROBATICS</b>	<b>AC</b>	It includes all movements in which there is no contact with the ground and has a well-defined aerial phase.
<b>LINK</b>	<b>LK</b>	The main function of these movements is to link or join two different categories. It also depends on the imagination of the dancer in question.

**Table 2.** Descriptive Analysis (total and by gender), T test, degree of significance and effect size of the sequential and temporal parameters of the breaking battles.

Parameters	Total		Men		Women		T test		Cohen's d	
	N	Mean ±DE (s)	N	Mean ±DE (s)	N	Mean±DE (s)	t	p	d	r
<i>GTP</i>										
Battle Time	60	162.23±33.63	30	172.787±36.65	30	151.69±26.98	2.537	.069		
Top Rock Time	60	52.82±13.88	30	52.14±15.78	30	53.50±11.93	-.377	.194		
Footwork Time	60	70.71±21.07	30	71.95±25.46	30	69.47±15.88	.452	.087		
Freeze Time	60	13.97±6.83	30	16.17±7.22	30	11.78±5.73	2.609	.250		
Powermove Time	60	19.13±12.32	30	25.34±13.57	30	12.92±6.69	4.491	.001*	1.160	0.502
Acrobatics Time	32	3.77±3.23	21	4.53±3.58	11	2.32±1.77	1.917	.005*	0.714	0.321
Link Time	58	5.97±5.10	29	7.38±6.03	29	4.57±3.53	2.165	.030*	0.569	0.274
<i>GSP</i>										
# of elements	60	39.50±12.23	30	48.67±9.60	30	30.33±6.20	8.787	.015*	2.270	0.750
# of Top Rock	60	7.73±2.33	30	9.27±1.96	30	6.20±1.54	6.730	.084		
# of Footwork	60	13.18±4.75	30	15.93±4.70	30	10.43±2.86	5.471	.038*	1.414	0.577
# of Freeze	60	8.42±3.56	30	10±3.67	30	6.83±2.66	3.819	.154		
# of Power Move	60	5.57±3.11	30	7.37±3.10	30	3.77±1.85	5.459	.035*	1.410	0.576
# of Acrobatics	32	2.09±1.59	21	2.48±1.80	11	1.36±.67	1.960	.017*	0.737	0.330
# of Link	58	3.60±2.34	29	4.52±2.70	29	2.69±1.46	3.196	.013*	0.843	0.388
<i>PTP</i>										
Element Time	60	4.73±1.43	30	3.93±1.14	30	5.54±1.24	-	.501		
Top Rock Time	60	7.59±3	30	5.96±2.08	30	9.21±2.92	-	.130		
Footwork Time	60	6.41±2.27	30	5.02±1.77	30	7.80±1.844	-	.468		
Freeze Time	60	1.68±.52	30	1.59±.35	30	1.78±.64	-	.019*	-	-
Power Move Time	60	3.60±1.88	30	3.570±1.45	30	3.637±2.26	-	.241	0.368	0.181
Acrobatics Time	32	1.77±1.06	21	1.848±1.18	11	1.64±.82	.504	.835		
Link Time	58	1.56±.54	29	1.493±.44	29	1.62±.63	-.974	.319		

\*  $p < 0.05$ . Expression of the effect size:  $d$  y  $r$ ,  $d < 0.2$  (zero),  $d = 0.2-0.49$  (small),  $d = 0.5-0.80$  (moderate) and  $d > 0.8$  (large). GTP= Global Temporal Parameters; GSP= Global Sequential Parameters; PTP= Partial Temporal Parameters.



**Table 3.** Descriptive analysis of the sequential and temporal parameters of breaking in the different phases of the men and women's competition, comparison between genders, t-test and degree of significance.

Parameters	Round of 16 (n=32)				Quarterfinal (n=16)				Semifinal (n=8)				Final (n=4)			
	Mean ±DE (s)		T test		Mean ±DE (s)		T test		Mean ±DE (s)		T test		Mean ±DE (s)		T test	
	Men	Women	t	p	Men	Women	t	p	Women	Men	t	p	Women	Men	t	p
<i>GTP</i>																
Battle Time	173.97±37.11	145.34±25.86	2.532	.017*	175.11±44.19	148.26±24.57	1.502	.155	163.62±23.41	159.71±19.39	.257	.805	172.23±50.88	200.23±5.27	-.774	.578
Toprock Time	50.50±14.04	53.21±12.72	-.573	.571	57.47±17.48	51.65±12.61	.764	.458	52.70±17.14	54.46±11.70	-.170	.871	42.91±28.37	61.39±4.27	-.911	.524
Footwork Time	72.08±28.84	67.89±11.518	.539	.594	65.90±18.68	60.75±20.31	.527	.606	71.77±16.81	80.98±4.26	-1.063	.329	95.59±40.35	94.04±.62	.054	.965
Freeze Time	16.03±7.31	10.08±4.42	2.784	.010*	17.90±8.04	14.67±7.31	.842	.414	10.89±5.03	9.38±4.26	.458	.663	20.99±.05	18.63±1.64	2.029	.291
Power Move Time	25.89±15.48	13.11±6.05	3.077	.006*	26.84±11.84	12.37±6.62	3.017	.009*	26.33±10.93	12.82±7.54	2.035	.088	12.97±8.91	13.93±16.38	-.073	.950
Acrobatics Time	4.46±3.85	2.16±1.83	1.711	.108	5.90±4.07	2.83±1.85	1.396	0.236	4.37±1.73	.61± -	1.886	.200	.53± -	-	-	-
Link Time	8.13±7.20	5.12±3.72	1.477	.150	5.06±3.90	4.19±4.04	.443	.665	6.66±4.67	4.22±2.34	.818	.451	12.52±4.28	2.25±.35	3.384	.180
<i>GSP</i>																
# of elements	52.13±10.77	28.88±4.70	7.914	.000*	43.50±7.11	29.63±7.56	3.782	.002*	45.50±5.80	34.25±6.94	2.486	.047*	48.00±5.66	37.00±7.07	1.718	.234
# of Top Rock	9.81±1.90	5.75±1.57	6.582	.000*	8.75±1.83	6.50±1.69	2.553	.023*	9.50±1.92	7.00±.82	2.402	.053	6.50±.70	7.00±1.41	-.447	.712
# of Footwork	17.44±5.35	10.19±2.81	4.796	.000*	13.50±3.96	9.13±2.23	2.720	.017*	15.00±2.16	12.50±1.73	1.806	.121	15.50±.71	13.50±4.95	.566	.669
# of Freeze	10.31±4.347	6±2.03	3.595	.002*	9.75±2.60	6.88±3.04	2.030	.062	7.75±2.63	8.25±2.63	-.269	.797	13.00±0	10.50±3.54	1.000	.500
# of Power Move	7.75±3.62	3.56±1.50	4.269	.000*	6.50±2.62	3.75±2.25	2.252	.041*	8.00±1.83	4.25±2.22	2.611	.040*	6.50±3.54	4.50±3.54	.566	.629
# of Acrobatics	2.69±2.01	1.20±.44	2.513	.024*	2.75±1.70	1.60±.89	1.312	.231	1.67±1.16	1.00± -	.500	.667	1.00± -	-	-	-
# of Link	4.93±3.08	3±1.63	2.203	.036*	3.63±2.26	2.38±1.19	1.383	.188	4.00±2.58	2.67±1.53	.786	.467	6.00±1.41	1.50±.71	4.025	.092
<i>PTP</i>																
Element Time	3.68±1.26	5.54±1.20	-4.260	.000*	4.34±.98	5.56±1.43	-1.982	.067	4.07±.80	5.36±1.51	-1.518	.180	3.99±1.66	5.88±1.36	-1.249	.342
Top Rock Time	5.48±1.98	9.86±3.11	-4.758	.000*	6.89±1.74	8.48±2.79	-1.369	.193	5.62±1.58	8.29±3.29	-1.465	.193	6.88±5.11	8.89±1.19	-.543	.676
Footwork Time	4.60±2.02	7.55±1.97	-4.193	.000*	5.37±1.13	8.03±1.70	-3.701	.002*	5.48±1.68	7.66±1.13	-2.156	.074	6.21±2.45	9.24±3.29	-1.044	.413
Freeze Time	1.55±.25	1.69±.44	-1.111	.276	1.78±.52	2.26±.82	-1.392	.186	1.37±.25	1.19±.57	.576	.595	1.62±.10	1.85±.47	-.712	.606
Power Move Time	3.44±1.33	4.05±2.61	-.830	.413	4.41±1.67	3.58±2.14	.858	.405	3.28±1.09	2.74±.78	.803	.452	1.91±.33	2.41±1.75	-.398	.755
Acrobatics Time	1.51±.63	1.65±.97	-.367	.718	2.12±.77	1.84±.67	.585	.577	3.36±2.35	.61± -	1.014	.417	.53± -	-	-	-
Link Time	1.48±.51	1.64±.62	-.821	.418	1.35±.26	1.61±.85	-.802	.436	1.53±.43	1.62±.16	-.351	.740	2.06±.23	1.62±.54	1.067	.441

\*  $p < 0.05$ . GTP= Global Temporal Parameters; GSP= Global Sequential Parameters; PTP= Partial Temporal Parameters.

**Table 4.** General descriptive analysis of the rounds, ANOVA and degree of significance of the sequential and temporal parameters of the men's breaking battles

Parameters	Rounds						ANOVA		
	Round1 (n=30)	Round2 (n=30)	Round3 (n=30)	Round4 (n=30)	Round5 (n=30)	Round6 (n=30)	F	gl	Sig.
	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)			
<i>GTP</i>									
Round Time	37.01±10.65 <sup>a</sup>	31.29±7.21	30.24±9.74	28.35±6.42	30.62±10.16	27.19±5.91	4.711	5	.000*
Top Rock Time	11.11±5.66	9.59±4.03	8.49±5.36	9.15±3.99	9.38±4.79	8.95±5.82	.962	5	.443
Footwork Time	15.18±8.17	12.42±5.40	14.51±8.10	12.43±5.29	14.62±7.13	12.12±4.53	1.224	5	.300
Freeze Time	3.61±2.34	3.69±2.09	3.24±2.67	3.00±1.77	2.61±1.36	3.35±2.76	.880	5	.496
Power Move Time	6.20±3.91	6.37±3.22	5.10±3.20	4.53±2.94	4.85±3.12	6.20±4.01	1.277	5	.278
Acrobatics Time	2.09±1.78	3.02±1.69	1.71±1.14	1.68±1.54	1.88±1.03	3.79±2.28	2.074	5	.090
Link Time	2.18±1.29	2.45±2.22	2.48±1.49	2.06±.96	2.30±1.45	1.46±.77	1.117	5	.357
<i>GSP</i>									
# of elements	9.70±3.32 <sup>a</sup>	8.50±3.04	7.40±2.88 <sup>b</sup>	7.80±2.46	8±2.80	7.10±3.12 <sup>b</sup>	2.970	5	.013*
# of Top Rock	1.80±.92	1.76±.92	1.40±.72	1.30±.65	1.63±.85	1.50±.68	1.598	5	.163
# of Footwork	3±1.26	2.67±1.42	2.57±1.22	2.67±1.35	2.73±1.28	2.30±1.09	.957	5	.446
# of Freeze	2.13±1.25	1.67±1.18	1.50±1.20	1.63±1	1.50±.94	1.5±1.33	1.347	5	.247
# of Power Move	1.53±1.07	1.43±1.01	.93±.94	1.20±.89	1.20±1.06	1.07±.98	1.515	5	.187
# of Acrobatics	.40±.89	.30±.60	.40±.56	.20±.41	.23±.50	.23±.43	.671	5	.646
# of Link	.83±.79	.77±.82	.60±.77	.80±.81	.70±.70	.83±1.18	.338	5	.889
<i>PTP</i>									
Element Time	4.25±1.84	4.03±1.30	4.84±3.11	4.04±1.75	4.27±2.26	4.99±3.59	.855	5	.512
Top Rock Time	7.03±3.93	6.60±3.83	6.57±5.16	7.23±3.77	6.45±4.17	5.78±3.94	.424	5	.831
Footwork Time	5.66±3.34	5.04±2.84	6.32±4.93	5.22±2.92	6.07±4.00	5.42±4.02	.509	5	.769
Freeze Time	1.70±.85	1.67±.78	1.73±1.11	1.53±.51	1.68±.80	1.49±.60	.372	5	.867
Power Move Time	4.12±3.02	4.31±2.83	4.10±3.31	3.34±2.62	2.94±1.97	4.93±4.10	1.205	5	.311
Acrobatics Time	1.14±.32 <sup>a</sup>	2.42±1.46	1.58±1.08	1.68±1.54	1.57±.43	3.22±1.87 <sup>a</sup>	2.469	5	.050*
Link Time	1.56±.83	1.73±.76	1.74±.98	1.69±.90	1.87±1.21	1.23±.52	1.063	5	.386

\*Significant differences present (p<0.05). <sup>a</sup>The category shows significant differences to the rest of the categories; <sup>b</sup>rounds 3 and 6 to the remaining others. TGP= Temporal Global Parameters; GSP= Global Sequential Parameters; PTP= Partially Temporal Parameters.

**Table 5.** General descriptive analysis of the rounds, ANOVA and degree of significance of the sequential and temporal parameters of women's breaking battles.

Parameters	Rounds						ANOVA <sup>1</sup>			ANOVA <sup>2</sup>		
	Round1 (n=30)	Round2 (n=30)	Round3 (n=30)	Round4 (n=30)	Round5 (n=2)	Round6 (n=2)	F	gl	Sig.	F	gl	Sig.
	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)	Mean±DE (s)						
<i>GTP</i>												
Round Time	41.82±9.64 <sup>a</sup>	40.85±8.70	38.71±9.18	35.67±7.80 <sup>a</sup>	35.56±.85	36.69±1.09	1.835	5	.111	2.840	3	.041*
Top Rock Time	14.83±6.16	14.50±5.09	12.68±6.08	11.47±4.01	12.12±.77	14.32±3.17	1.566	5	.175	2.518	3	.062
Footwork Time	20.44±6.83	19.00±6.24	19.12±4.94	17.43±6.49	15.89±4.45	15.41±.25	.963	5	.443	1.203	3	.312
Freeze Time	2.80±1.62	2.75±1.73	3.13±1.76	3.46±2.49	2.78±1.13	4.18±2.11	.620	5	.685	.792	3	.501
Power Move Time	5.17±3.48	5.13±2.75	4.14±2.59	3.78±1.76	5.07± -	5.59± -	.841	5	.525	1.349	3	.265
Acrobatics Time	1.26±.73	2.15±1.22	2.10±.83	1.21±.98	-	-	1.221	3	.348	1.221	3	.348
Link Time	1.86±.73	2.05±1.54	2.78±2.19	2.38±1.63	2.25±.35	-	.636	4	.639	.833	3	.482
<i>GSP</i>												
# of elements	7.13±2.40	7.60±2.50	7.57±2.70	7.27±2.60	7±2.83	4.50±.71	.660	5	.655	.240	3	.868
# of Top Rock	1.40±.67	1.60±.81	1.57±.68	1.47±.68	1.50±.71	1±0	.469	5	.799	.464	3	.708
# of Footwork	2.40±.81	2.73±1.14	2.63±1.07	2.43±1.14	2±1.41	1.50±.71	.913	5	.475	.698	3	.555
# of Freeze	1.70±1.09	1.43±.94	1.80±1.13	1.70±1.02	1.50±.71	1.50±.71	.429	5	.828	.679	3	.567
# of Power Move	.93±.69	1.10±.96	.77±.77	.90±.76	.50±.71	.50±.71	.746	5	.591	.876	3	.456
# of Acrobatics	.13±.35	.07±.25	.20±.41	.10±.31	-	-	.648	5	.664	.879	3	.454
# of Link	.57±.73	.67±.66	.60±.89	.67±.76	1.50±.71	-	.875	5	.500	.128	3	.943
<i>PTP</i>												
Element Time	6.59±2.73	5.96±2.42	5.78±2.77	5.52±2.45	5.51±2.10	8.24±1.05	.870	5	.503	.913	3	.437
Top Rock Time	11.64±5.75	10.80±5.25	9.03±5.68	8.76±4.63	8.95±3.71	14.32±3.17	1.466	5	.206	1.976	3	.122
Footwork Time	9.47±3.70	8.15±4.75	8.50±4.28	8.27±4.71	9.55±4.52	11.60±5.63	.533	5	.751	.559	3	.643
Freeze Time	1.62±.75	1.70±.95	1.80±.66	2.15±1.67	2.29±1.83	2.76±.11	1.110	5	.359	1.256	3	.293
Power Move Time	4.37±2.95	4.01±2.56	3.29±2.52	2.99±1.73	5.07± -	5.59± -	.953	5	.452	1.313	3	.276
Acrobatics Time	1.26±.73	2.15±1.22	2.10±.83	1.21±.98	-	-	1.221	3	.348	1.221	3	.348
Link Time	1.55±.80	1.67±1.04	1.86±1.01	1.72±1.19	1.62±.54	-	.151	4	.962	.195	3	.899

<sup>1</sup>Comparison of the 6 rounds. <sup>2</sup>Comparison of the first four rounds \*present significant differences (p<0.05). <sup>a</sup>The category shows significant differences to the rest of the categories. TGP= Temporal Global Parameters; GSP= Global Sequential Parameters; PTP= Partially Temporal Parameters.

**Table 6.** Comparison of the rounds between men and women, t-test, degree of significance and effect size of the sequential and temporal parameters of the breaking battles.

Parameters	Rounds																						
	Round1 (n=30)				Round2 (n=30)				Round3 (n=30)				Round4 (n=30)				Round5 (n=2)		Round6 (n=2)				
	T-test		Cohen's d		T-test		Cohen's d		T-test		Cohen's d		T-test		Cohen's d		T-test	T-test	Cohen's d				
	t	p	d	r	t	p	d	r	t	p	d	r	t	p	d	r	t	p	t	p	d	r	
<i>GTP</i>																							
Round Time	-1.835	.072			-4.633	.000*	-1.196	-0.513	-3.462	.001*	-0.895	-0.408	-3.970	.000*	-1.025	-0.456	-.676	.504	-2.236	.033*	-1.635	-0.373	
Top Rock Time	-2.431	.018*	-0.629	-0.300	-4.100	.000*	-1.067	-0.471	-2.805	.007*	-0.730	-0.342	-2.186	.033*	-0.580	-0.279	-.794	.434	-1.277	.212			
Footwork Time	-2.707	.009*	-0.699	-0.330	-4.319	.000*	-1.126	-0.491	-2.661	.011*	-0.687	-0.316	-3.235	.002*	-0.843	-0.387	-.246	.808	-1.009	.322			
Freeze Time	1.519	.135			1.709	.094			.188	.851			-.770	.445			-.174	.863	-.409	.686			
Power Move Time	.961	.341			1.396	.170			.979	.334			1.051	.300			-.068	.946	.150	.882			
Acrobatics Time	.868	.408			.665	.527			-.730	.477			.474	.650			-	-	-	-			
Link Time	.875	.389			.605	.549			-.405	.689			-.653	.521			.050	.961	-	-			
<i>GSP</i>																							
# of elements	3.428	.001*	1.177	0.507	1.253	.215			-.231	.818			.817	.417			.488	.629	1.159	.256			
# of Top Rock	1.914	.061			.562	.576			-.666	.508			-.712	.480			.323	.749	4.704	.000*	1.018	0.243	
# of Footwork	2.192	.032*	1	0.447	.391	.697			-.225	.823			1.037	.304			.939	.355	1.806	.082			
# of Freeze	1.300	.199			2.001	.051			.044	.965			.512	.611			.275	.786	.661	.515			
# of Power Move	2.215	.032*	1	0.446	.914	.366			.552	.585			.817	.419			.826	.419	.629	.536			
# of Acrobatics	1.698	.140			1.549	.172			.728	.478			-	-			-	-	-	-			
# of Link	.453	.654			1.007	.323			-.435	.667			.000	1.000			-.774	.450	-	-			
<i>PTP</i>																							
Element Time	-3.890	.000*	-1.005	-0.449	-3.865	.000*	-0.994	-0.445	-1.228	.225			-2.675	.010*	-0.697	-0.325	-.751	.458	-1.257	.219			
Top Rock Time	-3.624	.001*	-0.936	-0.424	-3.513	.001*	-1.174	-0.411	-1.741	.087			-1.360	.179			-.822	.418	-2.982	.006*	-2.180	-0.472	
Footwork Time	-4.195	.000*	-1.081	-0.475	-3.056	.004*	-0.955	-0.340	-1.836	.071			-2.964	.005*	-0.778	-0.261	-1.182	.247	-2.063	.049*	-1.510	-0.357	
Freeze Time	.340	.735			-.120	.905			-.319	.751			-1.852	.074			-.958	.346	-2.946	.007*	-2.165	-0.513	
Power Move Time	-.295	.769			.383	.704			.820	.418			.499	.620			-1.058	.302	-1.157	.877			
Acrobatics Time	-.307	.776			.241	.816			-1.015	.326			.474	.650			-	-	-	-			
Link Time	.003	.997			.171	.866			-.304	.764			-.090	.929			.285	.779	-	-			

\*presents significant differences (p<0.05). Expression of the effect size: *d* y *r*, *d*<0.2 (zero), *d*=0.2-0.49 (small), *d*=0.5-0.80 (moderate) y *d*>0.8 (large). GTP= Global Temporal Parameters; SGP= Sequential Global Parameters; PTP= Partially Temporal Parameters.

