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Intra- and inter- observer reliability of the Canyoning Assessement Tool

Confiabilidad intra e interobservador de la herramienta de evaluación Canyons

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Abstract: The numerous technical manuals or technical training does not guarantee a good technical level. Objective: Validate an instrument for evaluating the rope manoeuvres skills for canyoning - level I. Methods: 28 individuals, including beginners (<3 years of experience), and experienced practitioners (≥ 3 years of experience) in this sport. These presented an average age of 27.5 +- 7.89 years. The technical execution was recorded in video for further evaluation. This was done by three observers, all experienced in canyoning where two of them teaching this sport at University. The evaluation was replicated later over 20 days. Results: The results had good reliability levels, in the intra- and inter-class analyses, as in the test/re-test analysis. The Final Score variables present excellent reliability among the three observers. Conclusion: After analysing the results, we concluded that the CAT (Canyoning Assessment Tool) is a reliable instrument for evaluation skills in rope manoeuvres in canyoning.
Key-words: nature and adventure sports, technique, observation and analysis.

Resumen: Los numerosos manuales técnicos o cursos técnicos no garantizan un buen nivel técnico. Objetivo: validar un instrumento para evaluar las habilidades de maniobras con cuerdas para barranquismo - nivel I. Métodos: 28 individuos, incluidos principiantes (<3 años de experiencia) y practicantes experimentados (≥ 3 años de experiencia) en este deporte. Estos presentaron una edad promedio de 27.5 + - 7.89 años. La ejecución técnica fue grabada en video para su posterior evaluación. Esto fue realizado por tres observadores, todos con experiencia en barranquismo donde dos de ellos enseñaron este deporte en la Universidad. La evaluación se repitió más tarde durante 20 días. Resultados: Los resultados tuvieron buenos niveles de confiabilidad, en el análisis intra- y inter-clase, como en el análisis de prueba / re-prueba. Las variables del *Final Score* presentan una excelente confiabilidad entre los tres observadores. Conclusión: Después de analizar los resultados, llegamos a la conclusión de que el CAT (*Canyoning Assessment Tool*) es un instrumento confiable para las habilidades de evaluación en maniobras con cuerdas en el barranquismo.
Palabras clave: naturaleza y deportes de aventura, técnica, observación y análisis.

Introduction

Nature and Adventure Sports (NAS) is a recent area of sports (Melo & Gomes, 2017), which is expanding largely (Gallegos & Baena, 2010), both in the number of practitioners, federations and associations as well as tourists (Silva, Inácio, & Betrán, 2008). NAS offers emotions such as pleasure, fun and adventure (Lavoura, Schwartz, & Machado, 2008), coupled with low predictability, reduced monotony of movements, greater exposure to risk (Pimentel, 2013) and combined with the possibility of sharing these emotions with a group, without restrictions of age, sex or physical level, makes the valences of these activities unique (Betrán, 1995). Funollet (1989) already warned about the potential of activities in the natural environment (educational and social) and claimed that these would be a way for the population to escape from the city.

The lack of spatial boundaries has led to an uncontrolled proliferation of new activities of nature sport's (Yuba, Queixallós, & Betrán, 2016). However, we have some authors, such as Melo and Gomes (2017) and Bentley, Page and Edwards (2008), who organize these activities in different natural contexts, namely air, land and water. Betrán and Betrán (2016), propose the canyoning sport to be associated with water activities which have to do with pleasure and relaxation and at the same present some risk and verticality.

Canyoning has seen significant growth in several countries (Hardiman & Burgin, 2010). This sports consists of walking or swimming down through a canyon (Silva, Almeida, & Pacheco, 2014; Stephanides & Vohra, 2007), transposing vertical obstacles (Hardiman & Burgin, 2010). This modality is practiced in a natural environment and is influenced by several external factors, some of them very unstable and variable (Montesa & García, 2005), becoming challenging and risky (Soteras, Subirats, & Strapazzon, 2015). The underestimation of these risks, along with the lack of skills, are conditions that exponentially increase the probability of an accident (Silva et al., 2014). Although the risk factors are divided into environmental factors and human factors (Ayora, 2011, Ennes, 2013), the latter are referenced by practitioners as the ones that most influence the practice of canyoning (83%), namely in the technical and gear departments (Brandão, 2016). This technical component requires specific, progressive and continuous training, combined with regular workout that automates the execution and agility/speed of the manoeuvres (Abarca et al., 2001).

The lack of recognized technical personnel in the area of

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NAS (Carvalhinho, Rodrigues, & Serôdio-Fernandes, 2014) is a fundamental aspect to be taken into account, because, as Brandão (2016) refers, "... the training of practitioners and of the technicians proves indispensable to avoid any errors before the unforeseen ... "(p.14). At the technical level, there are several documents that can support a good training, such as basic manuals (Abarca et al., 2001, Castillo, 2015, EFDC & FFS 2001, FFME & FFS 2007), advanced manuals (Montesa & García, 2005) and also manuals of good practices (ABETA & Ministry of Tourism of Brazil, 2009). At the scientific level, we also find references regarding the training of CAT technicians (Carvalinho, Sequeira, Serdio-Fernandes, & Rodrigues, 2010; M. Silva, Carvalhinho, & Silva, 2014) or on emotional aspects (Carnicelli-Filho, 2013; Mackenzie & Kerr, 2013). However, as far as the evaluation of canyoning manoeuvres is concerned, our research only allowed us to discover one reference only, namely an individual training book corresponding to the manoeuvres in the French canyoning manual (EFDC & FFS, 1999).

Evaluation is a key element in pedagogy, consisting of verification and control of results and, proof and scheduling of learning (Pacheco, 1998). In a teaching-learning process, evaluation is directly associated with planning and realization, and the degree of achievement of the objectives (Setna, Jha, & Boursicot, 2010) can be determined. Methodological intentions are important to enumerate the measurable results of the learning action of the students (Bento, 2003). According to Vickers (1990), the evaluation can be judicious, using standards defined according to a model, or normative, comparing the final score with patterns associated with a larger population. It is important that the criteria be specific, simple and clear, thus increasing inter- and intra-observer reliability (Ekegren, Miller, Celebrini, Eng, & MacIntyre, 2009; Herrington, Myer & Munro, 2013; Padua et al., 2009).

Therefore, after analysing the existing references and considering the lack of specific evaluation frameworks for canyoning rope manoeuvres, we intend in this study to adapt and validate an instrument for the evaluation of level I canyoning manoeuvres.

Methods

Sample

The participants in this study were selected so as to constitute homogeneous groups, regarding their division in relation to their years of experience (Table 2.1). They all participated voluntarily in this research. Twenty-eight individuals, with a mean age of 27.5 +- 7.89 years, were evaluated.

One of the subjects, in the control group and with less than 3 years of experience, was removed from the sample by the observers due to the fact that he did not perform one of the essential manoeuvres.

Instruments

For the data collection, an iron structure was designed with the aim of providing similar conditions among all individuals, which was resistant, portable and easy to assemble/ disassemble. The structure is 200cm long and wide, with an adjustable height between 170cm and 220cm. On the upper edges of the inner side of the structure four belays stations were placed, consisting of two hangers with a ring each. We've chose this type of belay station because it is common, more economical and in this way, we can apply the four essential manoeuvres.

Standard equipment was used in the test, which facilitated the performance conditions. The gear was selected according to the specificity of this sport, taking into account the value, specific characteristics, utility and reputation among the practitioners: backpack "Formiga" by Rodcle; 20 meters rope Dana 9mm from Kordas; helmet "Elios" from Petzl; harness Iguazu II from Edelrid; Dyna Double Clip 40/75cm from Beal; 2 figure of eight from Petzl; 8 Rondo carabiners from Austrialpin; a few meters of 16mm slings from Fixe.

Procedures

The execution of the manoeuvres was performed in a parallelepiped structure, with a belay station constituted by two hangers with rings, with 180cm high. The equipment (backpack, helmet, harness, rope, hardware) used was the same for all participants, aiming to replicate the same conditions for all subjects, with the concern of being specific equipment for the canyoning modality. After a brief explanation of the study, the participants filled out a form with their demographic data. Finally, the subjects observed a clip relative to the first manoeuvre and then replicated what they saw and so on for the remaining manoeuvres in an isolated location. Each manoeuvre was demonstrated in the clip three times, in the first two demonstrations the video speed was reduced to 10% of the normal speed and the last clip was presented at normal speed. The executions of the manoeuvre was recorded through video for further evaluation.

After all the individuals performed the manoeuvres, the videos were analysed by three experts, in two moments: the test and the re-test, after 20 days. These three observers had common characteristics, such as being practitioners this sport, being canyoning trainers and having basic training in teaching sports, two of them being canyoning teachers in a university in the North of Portugal

The evaluation of the 27 individuals was performed simultaneously, however without any visual contact in-between the individuals, so that there was no influence among peers. Before beginning the observation of the clips, there was a meeting of the observers to discuss the observation grid. After that, the grid and the evaluation criteria remained unchanged. During the two evaluation processes and during the 20-day interval, observers were not able to discuss criteria or concrete assessments. Data was collected and transposed to SPSS 23.0 for further analysis.

The manoeuvres that we selected correspond to level 1 manoeuvres, which are covered in most of the canyoning initiation courses. In order to define the criteria to be used in these manoeuvres, we conducted a survey in canyoning books and manuals, where a certain technical detail was preferred, using criteria of ease of assembly and safety. We then justified the use of the various techniques and technical details according to the references used.

The manoeuvre 1 (Figure 2.1) corresponds to the placement of the descender on the rappel rope in "Vertaco" mode and blocking it; this is the first manoeuvre to be learned for the practice of canyoning (Castillo, 2015). We use the rope in single, because according to the previous author, it covers a greater number of manoeuvres possibilities. The placement of the descender in the rope using the "unmissable" method avoids the loss of it (Tolosa et al., 2014) and the use of the "Vertaco" mode avoids the possible realization of a lark knot and consequently the need for a rescue scenario (EFDC & FFS, 2001; FFME & FFS, 2007). The "Vertaco" mode is the assembly most used, for being more effective and safe, presenting more friction therefore we will be able to recover the rope in case we accidentally lose it and as such should be used by those who initiate themselves in this sport (Castillo, 2015). As the manoeuvre implies that the belays station is already in place, we will include the approach to the belay station as an execution criterion (Tolosa et al., 2014). The lock of the descender used was the mule knot because several manuals show that it is a blockade that can be executed in any circumstances (FFME & FFS, 2007). Finally, the decision to use the eight, as a preferential descender, has to do with the large number of users of this descender, since it is the most economical, most versatile (Algaba, 2010) and because it is the only one with few alterations, due to the great evolution of this market (Richard, 2014).

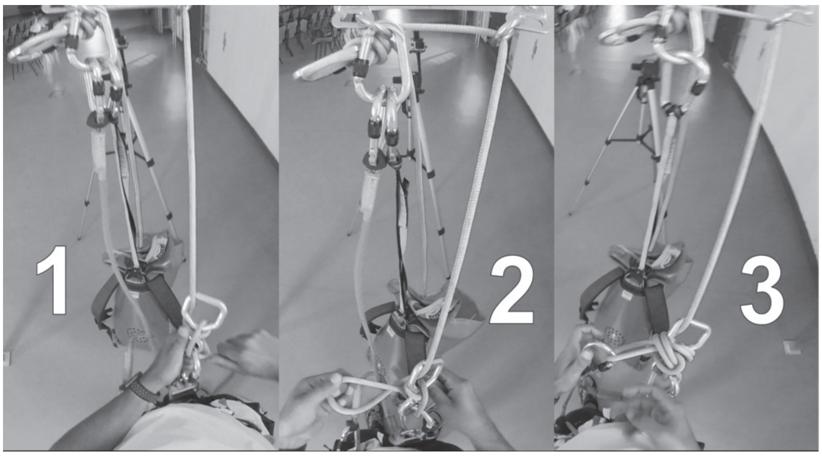

Figure 2.1. Graphical description of the manoeuvre 1: Approach to the belay station with placement of the eight descender in the rope and consequential lock of this one.

Criteria for the manoeuvre 2 success: i. placing the working carabiner and connect ourselves to it (Castillo, 2015); ii. place the backpack on the working carabiner (EFDC & FFS, 2001; Halli et al., 2013); iii. to pass the rope in the rings, so that the rappel rope is on the side of the working carabiner (EFDC & FFS, 2001; Halli et al., 2013); iv. adjust the end of the rope to reach the ground (EFDC & FFS, 2001; Halli et al., 2013); v. place a working carabiner and do an Italian hitch with the rappel rope (Castillo, 2015, EFDC & FFS, 2001; Halli et al., 2013); block the italian hitch with a mule knot (EFDC & FFS, 2001; Halli et al., 2013); vii. perform a half key (EFDC & FFS, 2001); viii. link the two hangers with a quickdraw, from the ring to the working carabiner (Algaba, 2010, Castillo, 2015, EFDC & FFS, 2001, Halli et al., 2013).

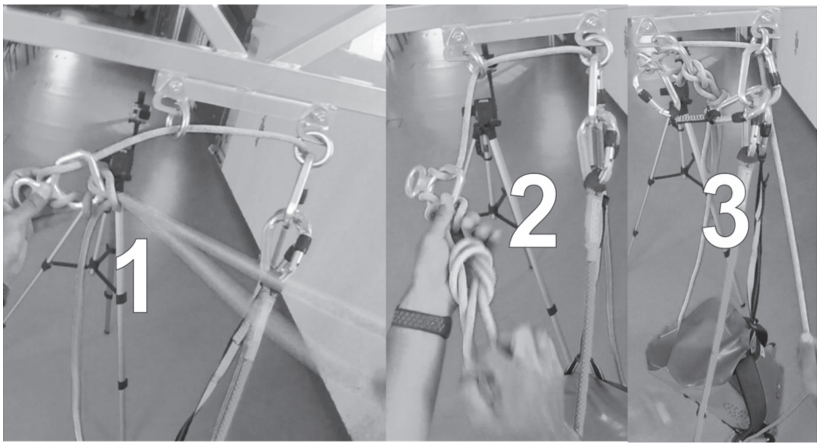

Figure 2.2. Graphic description of the manoeuvre 3: Assembly of a releasable abseil: with a figure of eight.

Criteria for the manoeuvre 3 success: i. placing the working carabiner and connect ourselves to it (Castillo, 2015); ii. place the backpack on the working carabiner (Halli et al., 2013); iii. pass the rope through the rings so that the rappel rope is on the side of the working carabiner; iv. adjust the end of the rope to reach the ground (EFDC & FFS, 2001; Halli et al., 2013); v. install the eight on the rescue rope (Castillo, 2015; EFDC & FFS, 2001; Halli et al., 2013); vi: do the "escape" knot (Castillo, 2015; EFDC & FFS, 2001); vii. followed by a half a key (EFDC & FFS, 2001; Halli et al., 2013); viii. (Fig. 1), place the quickdraw, from the small ring of the figure of eight block (Algaba, 2010; Castillo, 2015; EFDC & FFS, 2001; Halli et al., 2013).

Finally, manoeuvre 4 (Figure 2.3) corresponds to the setup of a retrievable handline without intermediate points. This manoeuvre allows us to approach a belay station, which is very exposed and possess the risk of falling (Castillo, 2015, EFDC & FFS, 2001; Halli et al., 2013), or simply to avoid complicated water movements (Soto et al. al., 2003). For this manoeuvre, there are two techniques, one in which the person descending takes care of his own safety, or a second one with the help of a team mate, in which he's in charge of the safety of the person descending. This last option has the advantage that the person that is descending, being able to have both hands free for more technical and horizontal progressions (Castillo, 2015; EFDC & FFS, 2001). The disadvantage to our test is that the evaluation is individual and putting a second element, modifies the results.

With the mastery of this level 1 manoeuvres, we can practically overcome all the vertical obstacles we can find in a canyon.

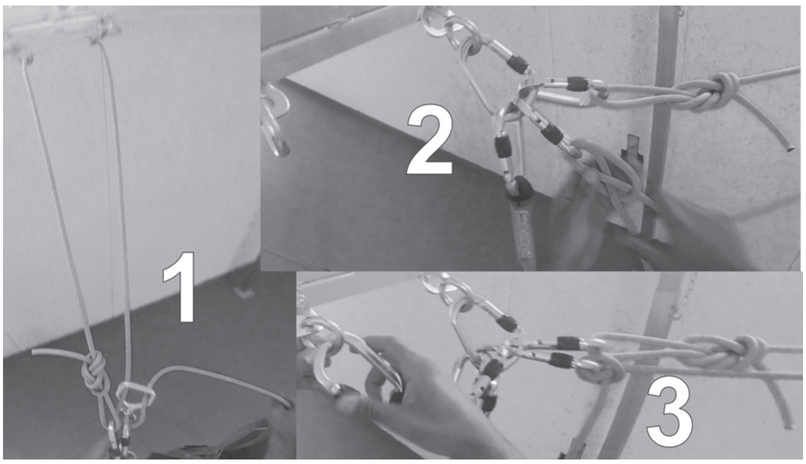

Figure 2.3. Graphical description of the manoeuvre 4: Retrievable handline without intermediate points.

Criteria for success of manoeuvre 4: i. place the backpack in our harness and pass the rope through the 2 ring hangers (EFDC & FFS, 2001; Halli et al., 2013); ii. make an eight know at the end of the rope and place it in the central ring of our harness using a carabiner (EFDC & FFS, 2001; Halli et al., 2013); iii. place the rope that comes out of our backpack into the descender in fast mode (EFDC & FFS, 2001; Halli et al., 2013); iv. progresses safely to the belay station and connect ourselves to the working carabiner (Castillo, 2015; Halli et al., 2013); v. remove the carabiner with the eight knot of the harness and place it in the working carabiner (Halli et al., 2013); vi. remove the rope from the descender and make a clove hitch on a carabiner and connect it to the working carabiner (Halli et al., 2013); vii. stretch the rope using the clove hitch (Halli et al., 2013); viii. to connect the two hanger with a quickdraw, from the one of the rings to the working carabiner (Algaba, 2010; Castillo, 2015; EFDC & FFS, 2001; Halli et al., 2013).

In all manoeuvres (1, 2, 3 and 4), the ninth criteria was the "manoeuvre's execution sequence", since criteria execution is important and because the ordered performance could jeopardize the safety of the practitioner in real situation (Ayora, 2011, Brandão, 2016).

The scale agreed upon was adapted from the FFME evaluation model assessment booklet, since the observers approved the use of it. The scale considers four parameters, in which the worst would be "Do not execute"; later "Execute with errors"; "Execute without error, but with hesitations"; and the best parameter is "Perform without errors and without hesitation". For later addition to the total execution time, we decided to transpose this nominal scale to an ordinal from 1 to 4, where 1 corresponded to the best execution ("Perform without errors and without hesitation") and 4 to the worst classification ("Do not execute") . The Final Score of the manoeuvre was performed by summing the scores of the various criteria, with the time in seconds (s):

Score Final manoeuvre = CAT + Execution time (s)

The lower the value of the Final Score the better the quality of the execution of the manoeuvres. The time variable was collected through video, subtracting the final manoeuvre time, with the initial time, in seconds. The initial and final moment of the manoeuvres was determined by placing the hands on the structure (beginning and end of the manoeuvre), which was demonstrated in the manoeuvre's clips.

Statistical procedures

Intra and inter-observer reliability was analysed using the intraclass correlation coefficient (ICC) test according to Bland and Altman (1986). The ICC is a relative measure that describes the variation between cases in relation to the total variation of the observers. The greater intra or inter-observer variation, the lower the ICC. The ICC ranges from 0 (unreliable) to 1 (completely reliable, unchanged). The reliability test was performed in 27 participants in the first and second evaluation (separated by a 20-day interval). The descriptive statistics of the results obtained by the participants were also produced and the results were segmented by quartiles. The tests were performed at $p < 0.05$ in SPSS statistics version 23.0 software.

Results

First evaluation

In the manoeuvre 1, there was an intra-class correlation (ICC) of 0.708 (0.528-0.841). In manoeuvre 2, an ICC of 0.912 (0.842-0.956) was found. In the manoeuvre 3, an ICC of 0.869 (0.769-0.933) was observed. In the manoeuvre 4, an ICC of 0.888 (0.801-0.943) was found. Considering the final score, there was an ICC of 0.936 (0.883-0.968).

Second evaluation

In the manoeuvre 1, there was an intra-class correlation (ICC) of 0.829 (0.707-0.912). In manoeuvre 2, an ICC of 0.802 (0.665-0.896) was found. In the manoeuvre 3, an ICC of 0.826 (0.702-0.910) was observed. In the manoeuvre 4 an ICC of 0.885 (0.797-0.942) was found. Considering the final score, there was an ICC of 0.927 (0.867-0.963).

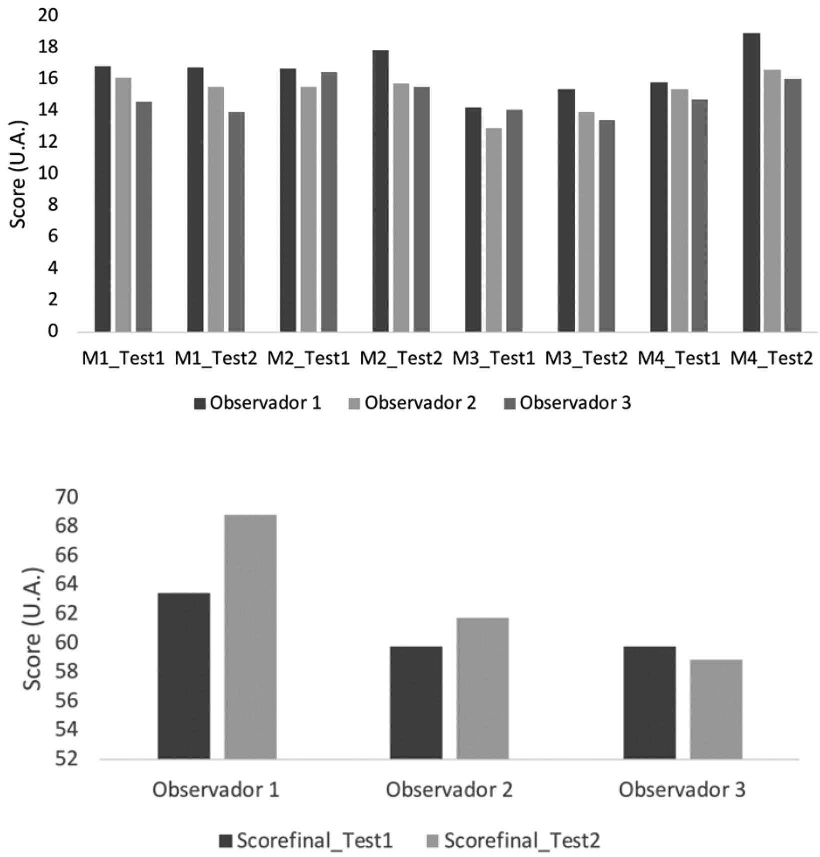

Figure 2.4. Mean of the observers in the test and the retest (after 20 days). Legend: M1-Maneuver 1; M2-Maneuver 2; M3-Maneuver 3; M4-Maneuver 4.

Intra-observer evaluation

An ICC was observed in observer 1 of 0.819 (0.641-0.913; good reliability) for manoeuvre 1. Regarding manoeuvre 2, an ICC of 0.781 (0.575-0.894) was found. In manoeuvre 3, an ICC of 0.866 (0.767-0.947) was observed. In manoeuvre 4, a CHF of 0.750 (0.522-0.877) was found. Finally, in the final score, an ICC of 0.920 (0.833-0.963) was observed.

Regarding the observer 2, an ICC of 0.879 (0.752-0.943) was observed in the manoeuvre 1. In the case of manoeuvre 2, an ICC of 0.871 (0.737-0.939) was found. In manoeuvre 3, the ICC was 0.836 (0.672-0.922). As for manoeuvre 4, the-ICC was 0.894 (0.781-0.950). Finally, in the final score the ICC was 0.922 (0.837-0.964).

As for the observer 3, an ICC of 0.824 (0.650-0.916) was observed in the manoeuvre 1. Regarding manoeuvre 2, there was an ICC of 0.845 (0.689-0.926). In manoeuvre 3, an ICC of 0.682 (0.414-0.841) was found. As for manoeuvre 4, the ICC was 0.821 (0.646-0.914). As to the final score, there was an ICC of 0.928 (0.849-0.967). In Figure 2.4, we graphically present the final score results described above.

Quartiles

With the results obtained by the participants during the four manoeuvres, quartiles were produced, distributing the performance in terms of run time, technical execution and final score (Figure 2.5).

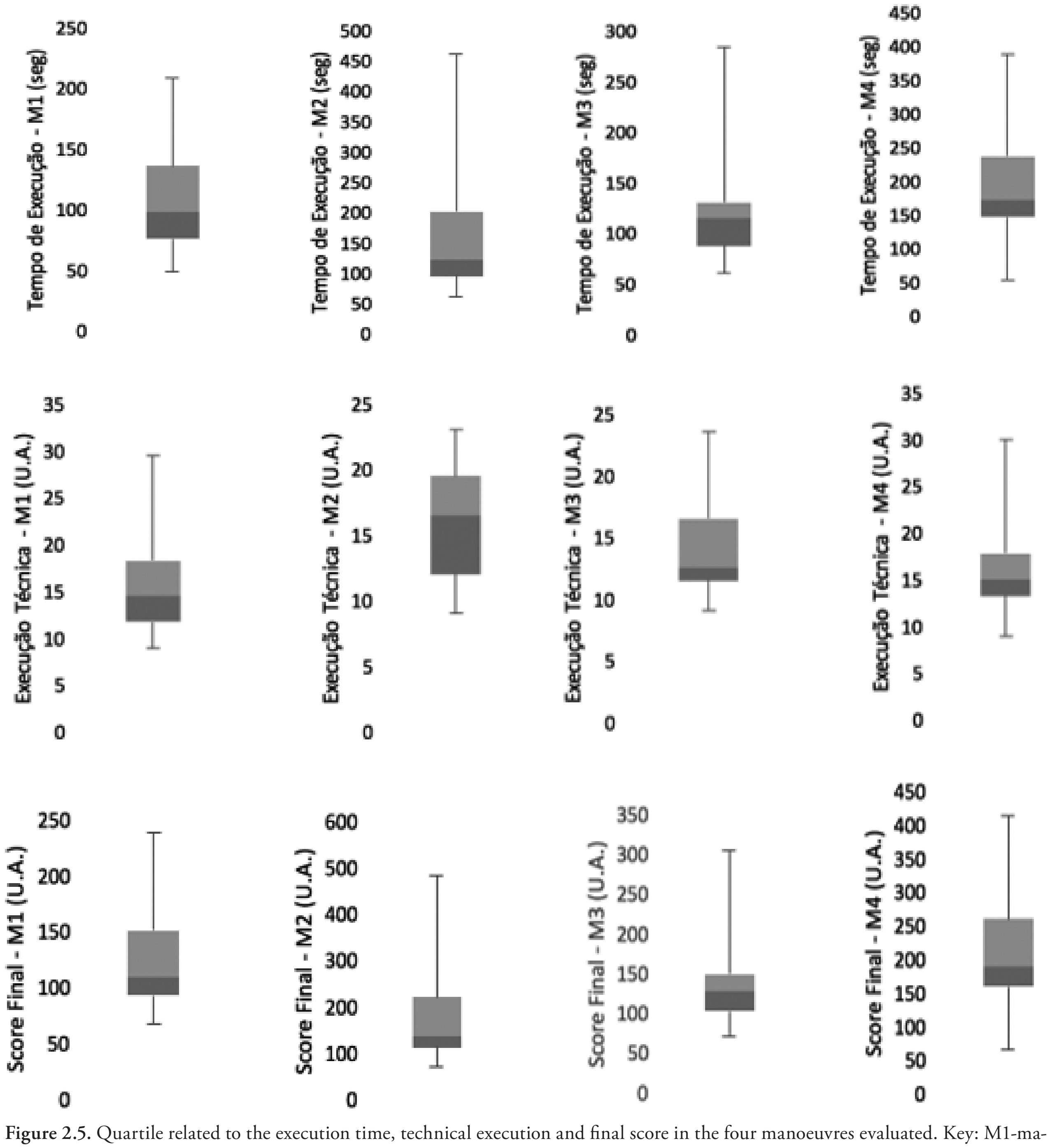

Figure 2.5. Quartile related to the execution time, technical execution and final score in the four manoeuvres evaluated. Key: M1-manoeuvre 1; M2-manoeuvre 2; M3-manoeuvre 3; M4-manoeuvre 4.

It was verified that in the manoeuvre 1 the average, the smallest value and the maximum value for the execution time were 98, 49 and 208 seconds respectively. For technical execution, the average is 16.5, the minimum value is 9 and the maximum value is 23 arbitrary units (A.U.). For the Final Score variable, the average is 134, minimum value of 70 A.U. and a maximum value of 483 A.U.

In manoeuvre 2, it was verified that for the variable execution time, the average was 122 seconds, minimum value of 61 seconds and maximum value 460 seconds. Relative to the technical execution variable, the average is 16.5 U.A, minimum value of 9 A.U. and the maximum value of 29.5 A.U.

It is shown in manoeuvre 3, for the variable execution time, the average of 115 seconds, the lowest value of 60 seconds and a maximum value of 283 seconds. In the variable time, the execution time has an average of 12.5 A.U., smaller value and greater value of, 9 and 23.5 A.U., respectively. For the final score, the average is 127 A.U., minimum value of 69 A.U. and maximum value of 304 A.U.

For the last manoeuvre, the average, mean value and maximum value for the run-time variable are 171, 52, 388 seconds respectively. For the technical execution variable, the average was 15 A.U., minimum value of 9 A.U. and maximum value of 30 A.U. Finally, the final score has an average of 190 A.U., minimum value of 66 A.U. and a maximum value of 414 A.U.

Discussion

The purpose of the present study was to evaluate the reliability of a Canyoning Assessment Tool (CAT). For the validation of this instrument, the evaluations of the executions were carried out by three observers and repeated after 20 days. This method of reliability analysis is used in many other studies, especially in the medical field (Koo & Li, 2016), obtaining correlation data between the various observers and between the two evaluations of each observer.

For the variation between data evaluated by an observer in two or more tests (Koo & Li, 2016), intra-class correlation, the results presented strong reliability. We found that there is an agreement between what observers evaluate, so we can extrapolate that for experienced observers in this sport and in teaching rope maneuvers, the instrument is strongly reliable (Zagatto, Beck, & Gobatto, 2009). Studies indicate that clear, well-defined classification criteria that are easy to assess and interpret have better intra- and inter-class results (Ekegren et al., 2009; Padua et al., 2009). Consequently, we can understand that the CAT has a potential applicability, but it is important that the study of this in the field continues to be analysed, adapting the instrument to the needs and feedback of the users.

In order to strengthen the credibility of this instrument, we conducted the evaluation, after 20 days, with the same observers and with the same conditions. This procedure was performed in order to verify intra-observer reliability (Koo & Li, 2016). Interpreting the results related to the correlation coefficient, we noticed that in the majority of the variables the ICC was superior to 0.75, indicating good reliability. Only in the Final Score variable, this result was higher than 0.90, revealing an excellent reliability of this variable (Hoeboer, Krijger-Hombergen, Savelsbergh, & Vries, 2017). In order to emphasize this reliability, the same results were the same in all three observers. The results were really positive, in all the statistical analyses that we performed, demonstrating that CAT is a reliable instrument for the evaluation of rope manoeuvres in the canyoning sport. Studies using identical statistical procedures and strong reliability, determine that the evaluation criteria are adequate (Frohm, Heijne, Kowalski, Svensson, & Myklebust, 2012; Reimer, Cox, Boonstra, & Nijhuis-van der Sanden, 2015).

Finally, we distribute the results in quartiles so that reference values can be used for future interventions or comparative studies. We analysed the variables execution time, technical execution and final score. This will help to frame the practitioners according to their level of proficiency in the categories execution time and technical execution, being more assertive the correction to be made by the technician. It is also important to separate the standard values of these variables so that they are used in training situations, where the evaluation of the technical execution is more important for the control of learning than the execution time itself.

Despite the positive results found, we cannot finish yet the study of this instrument. It is important in the future to see if strong trust relationships are maintained for real-time evaluations (Herrington et al., 2013), which will be used more often than video recording. An important aspect to be improved is a security aspect relating to the criterion of "joining the two belay station hangers". This criterion is evidenced in the four manoeuvres and is not always valued, since it varies according to the type of belay station. As we use as belay stations, two independent hangers with rings, it is fundamental that in all manoeuvres, this action appears at the beginning of the manoeuvre, so that the practitioners is always attached to two points, whenever performing any manoeuvre (Castillo, 2015). In future studies, it may be important to realize the extent to which the instrument is reliable for different observers, relative to the years of experience, in order to synthesize and facilitate the application of the instrument in various populations.

Practical applications

The main transfer to practice is the importance of having a reliable evaluation instrument for rope manoeuvres in canyoning. This allows trainers and teachers to replicate and use it as a way not only to evaluate learners, but also as a way to control the teaching-learning process. Trainees can now see what performance level they are when comparing their results with the reference values (quartiles). This instrument, when replicated properly, can compare results anywhere in the world. This allows comparing the technical level of several individuals and is an important tool for further research in this area of adventure and nature sports.

Conclusion

After analysing the results and limitations, we realized that the objectives of this study were relevant to the canyoning sport. The results show us great to excellent degrees of reliability for the Final Score variable, as such we can say that the instrument is reliable to be applied to the population. It is important that the application is the closest to what was done, namely, the type of gear used, the type of belay stations, the structure typology and the characteristics of the observers. An important step will be the validation of the instrument for the French, English and Spanish language, so that more individuals can use this instrument, thus increasing the database and the representativeness, of the standard values.

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