

## Mawashi-gueri Analysis in Karate – The Anticipation Problem

**Ana Catarina Rocha Mendes Fernando**

University of Madeira  
Portugal

**António Manuel Neves Vicente**

University of Beira Interior  
Portugal

**João Filipe Pereira Nunes Prudente**

University of Madeira  
Portugal

**Helder Manuel Arsénio Lopes**

University of Madeira  
Portugal

**Catarina Fernando, PhD.**

Department of Physical Education and Sport  
University of Madeira  
Caminho da Penteada, 9000 - 390 Funchal  
Portugal

### Abstract

---

*The aim of this study is to understand if the execution time of the mawashi-gueri technique in a competition situation enables the reading of indicators in the opponent movement in order to anticipate a response and if there is a significant difference between the movement runtimes of high-level karatekas and average experienced karatekas. The quantification of the runtime of the mawashi-gueri was held in an ecological situation from videos of international and national competitions. Results indicate that the time required in performing mawashi-gueri (280-480ms) is lower than the average choice reaction time suggested in literature. We verified that the times for the execution of this technique were not significantly different for the different practitioner's level. We concluded that in combat, to prevent an attack from a mawashi-gueri the karateka should start the reaction process (choice reaction time) before the opponent starts the technique, as it is usually described.*

---

**Key-words:** Karate, Reaction Time, Martial Arts

### 1. Introduction

Combat sports are activities where the interaction between the athletes is essential, because the ability to take any action will depend not only on the individual sportsman capacity and his limits but also of the possible balance between these factors taking into account his opponent. Despite this relationship being assumed in various studies in this area, we found, however, that many of the available data within this embodiment are fundamentally related to aspects of the sportsman's individual factors, in particular, physiological, motors, psychological factors (Beneke *al*, 2004; Neto *al*, 2006; Doria *al*, 2009).

Karate, as a combat sport, implies a relationship between the sportsman and his opponent and not only the enhancement of the individual movement.

If we consider the taxonomy proposed by Almada (1992) combat sports can be studied based on the taxonomic model useful  $F > \text{useful } F'$ , that is, for the individual to get advantage over the opponent, the useful force that he can exert on the opponent will have to be greater than the useful force the opponent can respond to his attack, whether through the defense, avoidance or at the reception of impact. The most striking features of this type of activity give priority to the "confrontation of the I" confronting critical situations (the notion of death, even if it symbolized, is always present and in the dialogue with the other)." (Almada *al*, 2008, p.253).

This approach leads us to consider that for the lessons learned from the karateka that can be operationalized in training reality, it is necessary to interpret them and integrate them in concrete situations, taking into account the interrelationship with the opponent (useful  $F > F'$  useful).

It is also assumed in the literature that one of the fundamental aspects in sport in general, and therefore also in karate, is the perception of motion, so the performance can not be analyzed solely by the movement execution capacity (Ripoll *al*, 1995; Williams & Elliott, 1999; Mori *al*, 2002). In this perspective, the process of gathering information to respond to an action can be divided into several phases: detection of the stimulus, differentiation, recognition and identification (Proctor & Dutta, 1995).

The ability to perceive the intention of the opponent depends of a set of perceptual-cognitive skills, such as: a) advance gather information on the postural orientation of the opponent; b) identify familiar stimuli in standard situations; c) exploration of the visual scene in an efficient and effective manner; d) verify the most likely options to face the opponent at a given moment and time (Williams, A. , 2009).

Thus, understanding the stimulus that the karateka can have available for preparing his response will depend, of course, of his reaction time, but also of his opponent time to carry out the attack and from the indicators provided on the action.

There are already some studies in this area that measure reaction times seeking to have an application character in this sporting activity, although some are based on the use of standardized tests where the stimulus is not specific to the sporting activity (Nougier *al*, 1990; Lee *al*, 1999).

Other studies used as stimuli their own Karate techniques, being, however, the answer to the individual undifferentiated required for the activity (Williams & Elliott, 1999; Mori *al*, 2002). It highlights yet another aspect where for karate undifferentiated stimuli are used, but where it measures the total time that the sportsman takes to make his own activity action (defensive or offensive) (Roosen *al*, 1999). There are similar studies but in other combat sports that nor karate (Ripoll *al*, 1995).

From the literature review, we can thus see that most of the studies does not use ecological situations in carrying out the techniques which in our opinion may be an artifact that influence the collected data from the time of execution of techniques or even the reaction times. If this clearance of the situations in relation to the combat reality is justified in the measurement of reaction times, it is impossible (at least with the use of non-intrusive instruments) identify and differentiate the stimulus, such is no longer the same with the technical execution.

Thus, in this study we want to understand if the times of the execution of techniques carried out in competitive situation (mawashi-gueri) allow a reading of indicators on the opponent's movement that allow to anticipate an adequate and cost-effective response and if there is a significant difference between the movement execution times of high-level karatekas (world class) compared to karatekas with some national competition experience. To do this we will focus on the study of the mawashi-gueri, one of the kicks used in most competing combat situations (Koropanovski *al*, 2008). Based on the collected data for the execution of the mawashi-gueri technique we will make an analysis of these reaction times comparing them with previous studies.

## 2. Methods

To determine the execution time of the mawashi-geri, we have quantified the duration of this movement in: 1) a fighting ecological situation from films of the semi-finals and final of the senior Karate World Championship in 2010 in Serbia in various weight classes and; 2) a fighting ecological situation from films of senior National Competitions in Portugal in 2010.

The time duration of the technique was considered from the moment when the lower limb which made the attack started the displacement in the direction of the blow, until the time when it started the contact with the opponent or, in case of avoidance, until the moment that the end of lower limb (foot) intersected the line where the impact would be.

In the first situation (1) 20 videos of fights were displayed at 25 frames per second (1 frame - 40ms) and quantified the mawashi-gueri execution times whenever the camera angle was considered appropriate to view the criteria set out above .

To accomplish this selection were previously viewed videos and images chosen, then being edited on a film (with the use of Adobe Premiere Pro C4) from which all measurements were performed.

In the second situation the procedures were the same as in the previous situation.

Data collection was performed by three investigators then the differences were analyzed to ensure the data reliability. The unmatched values have been reviewed by three researchers and measured again after discussion of the application of the criteria.

Data was analyzed using SPSS software (version 18.0.) and was used the T statistic test (Hypothesis Testing) and the chi-square test.

After collecting the data we compared the values obtained in the execution of mawashi-gueri technique with the existing values in the literature for the choice reaction time.

### 3. Results and discussion

#### 3.1.Data presentation

Data collected in combat from films of the semi-finals and final of the World Championships Karate (situation 1) and from the National Competition films of Karate in Portugal, are summarized in Table 1.

**Table 1 –Mawashi-gueri execution data (mean time, standard deviation, maximum and minimum value)**

Mawashi -guer n=30	Situation 1	Situation 2
Mean time	376ms	377ms
Standard deviation	55ms	45ms
Maximum value	440ms	480ms
Minimum value	280ms	280ms

Situation 1: Karate World Championship combats in 2010 in Serbia - senior; Situation 2: Karate National Tournament combats in 2010 (Portugal)- senior

Based on these data (and considering the p-value of 0.05), we can thus conclude that there has been a significant difference between the times obtained for the execution of the mawashi-gueri in competitive situation with high level karatekas (situation 1) and the times obtained in the competitive situation with a medium level of karatekas (situation 2) in the considered weight class.

The mean values obtained in performing the mawashi-gueri technique were very similar. In situation 1 we obtained an average time of 376 ms and in situation 2 an average time of 377 ms.

In the case of the minimum values of the execution of the technique we verified that they were equal between the two situations (280 ms), however, with regard to the maximum values we could verify that in situation 1 there was a lower 40ms time (440ms) that in situation 2 (480ms).

#### 3.2. Data analysis based on literature reaction times choices

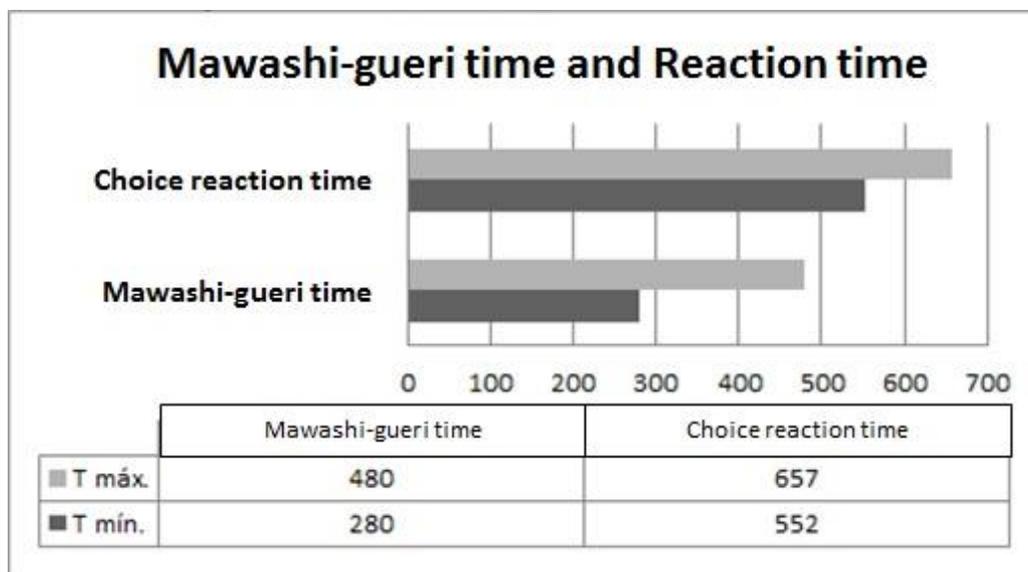
From the literature revision performed it was possible to find some reference values for the choice reaction time, although it is not possible to compare them due to the diversity of the types of tests used, the samples used, the types of stimuli or characteristics for example. Data presented, although not allowing to extrapolate the values of reaction time of more environmentally friendly choice to combat situations, give us, however, a sense of possible values for this variable, as we can see in table 2.

**Table 2 - Data and characterization of reaction times according to some published studies**

Author and year	Characteristics	Time values
T1 (DAVRANCHE al, 2006)	Sample of experienced practitioners on sports activities in situations that use time of choice reaction, especially combat sports. Stimulus and response non-specific of sporting activity.	Mean time 484-514ms
T2 (BRITO al, 2011)	Sample of karate practitioners with different levels and ages. Stimulus and response non-specific of sporting activity	Mean time by graduations 426-496ms
T3 (O'DONOVAN al, 2006)	Sample of martial arts practitioners senior level. Stimulus and response non-specific.	Mean time Control group 343.10ms Practitioners group 312.33ms
T4 (MORI al, 2002)	Sample karate practitioners, experienced and not experienced. Specific stimulus with a video karate techniques but non-specific response.	Mean time Experienced group 552 ms Less experienced group 657ms

Considering that the only study which is based on specific stimuli of sporting activity (Mori *al*, 2002), and, therefore, one that comes closest to a real combat situation, the values we consider most appropriate for the present study link to a range between 552ms and 657ms. However, even if we considered the average of the values presented in other studies that does not alter the relationship between the times.

Table 3 –Relation between the time of choice reaction on presented literature with the time of mawashi-gueri technique realization collected.



Maximum time and minimum of data collected in the mawashi-gueri performing; Maximum and minimum time in the choice reaction time based on presented literature.

Through these data (Table 3) we can easily understand that the execution time of the mawashi-gueri do not support the ability to avoidance or defend this technique if the reaction time of the karateka that receives the attack only starts when the mawashi-gueri movement begins. As we can see in the chart, the maximum time for execute the mawashi-gueri is less than the minimum length of the choice reaction time, even without considering that to prevent the attack it would still be necessary to add to the choice reaction time the movement time of the defense or avoidance technique.

Thus, in order to defend or elude the mawashi-gueri technique, as often observed in competitive situations, it will be essential that the stimuli considered to start the reaction time of choosing of who defends needs to start before the attacker initiate the technique.

### 3.3. Results discussion and conclusions

The speed of attack in karate is a widely known factor, however, most existing data in terms of quantification of the performance time of the various techniques relating to situations are usually performed in a laboratory context. Villani *al* (2009) refer execution times of a mawashi-gueri between 610-640 ms, also Mori *al* (2002) reported times for the various techniques used in their study (punch and kick techniques) between 430-660ms.

Thus, it is not at all surprising that the times we have collected in competing combat situations are inferior than other studies (280-480 ms), however, the important is not the difference in the data, but the implications that the values may have in training and performance analysis of karatekas.

Data obtained in our study indicates that the time required to perform the mawashi-gueri technique is lower than the average choice reaction time referred in the literature. This means that, in a combat situation, to avoid an attack from a mawashi-gueri is necessary that the karateka start his reaction process (choice reaction time) before the "technical execution". Let us remember that the values of choice reaction time quantify the time ranging from the stimulus until the start of the motor output and, therefore, the time to prevent the attack beyond the reaction time would still be necessary to add the defensive movement time (avoidance or defense), which makes the data difference even greater.

This times relationship reinforces the view that karate should not be considered on the basis of an isolated perspective of enhancing individual performance but the preponderance of the need for interaction between the attacker and defender, as is highlighted in some models of understanding of this activity, where the dialectic between individuals (useful F > useful F') is evidenced (Almada, 1992; Almada *al*, 2008).

However, many karatekas can defend or avoid an attack using this technique, which means that there are indicators that allow to detect the attack in time to decide and execute a defensive action.

At a training level we highlight the need, as evidenced by the data, to train the reading of indicators that allow understand the attack that will be executed in order to prepare a response. A reading of indicators that can not be trained performing exercises where the attacker is limited to make, for example, the technique from a set of initial position since, as we have seen, in competition situations the stimuli used to take the decision happen before the execution of the technique (mawashi-gueri in the studied situation).

Another conclusion we can draw according to the data collected, is that the execution time of the mawashi-gueri technique is not an indicator of the karate practitioner level, because the values quantified in world-class competitive situations compared to values of national competitions do not differ significantly. It should be noted that in national competitions the considered sample did not include the three national kumite competitors who took part in the World Karate Championship in Serbia in 2010.

While we cannot conclude which variables in the highest competitive level practitioners differ from other practitioners, if this is not the case in the motor output, it is likely that this distinction can be related to the stimulus detection process, differentiation, recognition and identification and / or decision-making.

## References

- Almada, F. (1992). *Cadernos da Sistemática das Actividades Desportivas nº 2 - Apresentação da Base Conceptual da Sistemática das Actividades Desportivas - Taxonomia e Modelos de Tratamento do Conhecimento*. Cruz quebrada: Faculdade de Motricidade Humana.
- Almada, F., Fernando, C., Lopes, H., Vicente, A., & Vitória, M. (2008). *A Rotura*. Torres Novas: V.M.L.
- Beneke, R., Beyer, T., Jachner, C., Erasmus, J., & Hütle, M. (2004). Energetics of karate kumite. *European Journal of Applied Physiology*, 92:518-523.
- Brito, A., Silva, C., Cid, L., Ferreira, D., & Marques, A. (2011). Atención y tiempo de reacción en practicantes de kárate Shotokan. *Revista de Artes Marciais Asiáticas*, 6(1), 142-156.
- Davranche, K., Audiffren, M., & Denjean, A. (2006). A distributional analysis of the effect of physical exercise on a choice reaction time task. *Journal of Sports Sciences*, 24(3), 323-329.
- Doria, D., Veicsteinas, A., Limonta, E., Maggioni, M., & Aschieri, P. (2009). Energetics of karate (kata and kumite techniques) in top-level athletes. *Journal of Applied Physiology*, 107: 603-610.
- Dyson, R., Smith, M., Martin, C., & Fenn, L. (2007). Muscular recruitment during rear hand punches delivered at maximal force and speed by amateurs boxers. *XXV International Symposium on Biomechanics in Sport*. Ouro Preto, Brazil.
- Koropanovski, N., Dopsaj, M., & Jovanovic, S. (2008). Characteristics of pointing actions of top male competitors in karate at world and european level. *Brazilian Journal of Biomotricity*, 241-251.
- Lee, J., Matsumoto, T., Othman, T., Yamauchi, M., Taimura, A., Kaneda, E., Kosaba, M. (1999). Coactivation of the Flexor Muscles as a Synergist with the Extensors during Ballistic Finger Extension Movement in Trained Kendo and Karate Athletes. *International Journal for Sports Medicine*, 20:7-11.
- Mori, S., Ohtani, Y., & Imanaka, K. (2002). Reaction times and anticipatory skills of karate athletes. *Human Movement Science*, 21: 213-230.
- Neto, O., Magini, M., & Saba, M. (2006). Análise cinemática de um movimento de Kung-Fu:A importância de uma apropriada física para dados obtidos através de câmaras rápidas. *Revista Brasileira de Ensino de Física*, volume28, n.2, 235-239.
- Nougier, V., Stein, J., & Azemar, G. (1990). Covert orienting of attention and motor preparation processes as a factor success in fencing. *Journal of Human Movement Studies*, 19: 251-272.
- O'Donovan, O., Cheung, J., Catley, M., McGregor, A., & Strutton, P. (2006). An investigation of leg and trunk strength and reaction time of hard-style martial arts practitioners. *Journal of Sport Science and Medicine*, 5-12.
- Proctor, R., & Dutta, A. (1995). *Skill Acquisition and Human Performance*. Thousand Oaks, CA: Sage Publications.
- Ripoll, H., Kerlirzin, Y., Stein, J. F., & Reine, B. (1995). Analysis of information processing, decision making, and visual strategies in complex problem solving sport situations. *Human Movement Science*, 14, 325-349.
- Roosen, A., Compton, G., & Szabo, A. (1999). A device to measure choice reaction time in karate. *Sports Engineering*, 2: 49-54.
- Villani, R., Ceccacci, A., Gasperini, D., Distaso, M., & Giangrande, M. (2009). Evaluation of the rapidity reaction in karate. *13th Congress of the ECSS* (pp. 66,67). Oslo, Noruega: ECSS.
- Williams, A. (2009). Perceiving the intentions of others: how do skilled performers make anticipation judgments? *Progress in Brain Research*, 174: 73-83.
- Williams, A., & Elliott, D. (1999). Anxiety, expertise, and visual search strategy in karate. *Journal of Sport & Exercise Psychology*, 21, 362-375.