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Attentional Characteristics of Fencers: a Comparison with Swimmers and Non-Athletes and their Pedagogical Implications

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Abstract: *The aim of this study was to identify the attentional profile of fencers, comparing them to non-athletes and swimmers. Three groups of subjects were studied (N=90; Mage=21.3; SD=4.1): thirty-seven fencers (20 female, 17 male), twenty-one swimmers (10 female, 11 male); thirty-two non-athletes (16 female, 16 male). Results of the alertness test (warning condition) showed swimmers were overall faster than non-athletes. In the no-warning condition, results of the alertness test showed a significant interaction between group × gender: in particular, it was the group of female non-athletes in the condition in which the warning signal was not present who recorded higher reaction times than the other groups. In the divided attention (only in the visual task), and the go/no-go tests, the fencers showed faster reaction times than the swimmers and the non-athletes, while the latter groups did not differ from each other. In the vigilance test, only the gender factor was significant: overall, males showed greater speed than females. In conclusion, our data show that fencers, compared to swimmers and non-athletes, possess better management of visual attention and a better ability to manage situations in which a response must be inhibited, suggesting that these differences affect more selective aspects of attention.*

Keywords: *attention; fencing; reaction times; alertness; go/no-go; divided attention; vigilance; gender differences.*

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Literature review

Fencing is a discipline that engages cognitive processes, particularly perceptual, executive, and motor functions (Gu et al., 2019; Rossi et al., 1992; Taddei et al., 2012; Zhang et al., 2015). During a fencing competition, situations change rapidly, requiring flexibility and the adaptation of strategies (Gu et al., 2019; Taddei et al., 2012; Zhang et al., 2015). A characteristic of fencing is an intensive mental load, common to some open-skill sports (e.g., Gu et al., 2019). In other words, "the inconsistent element" in this sport demands a mental effort, requiring a continuous controlled mode of processing (Rossi et al., 1992). However, compared to other open-skill disciplines, fencing requires faster and more accurate responses, given that the distance between the two competitors is particularly reduced (Rossi et al., 1992). Due to the function cognitive processes have in determining competitive outcomes, fencing represents an interesting field of study.

Previous studies on the visual exploration strategies of fencers have highlighted the importance of the role played by the peripheral vision system (Ripoll, 1987). However, others have indicated the type of strategies top-level athletes use, providing further information on elements within the fencer's field of vision (Bard et al., 1981; Hagemann et al., 2010). Regarding attentional research, studies carried out using Posner's paradigm revealed that fencers are able to distribute their attentional resources over space, utilising a strategy minimizing attentional costs (Bisiacchi et al., 1985; Nougier et al., 1996). The superior skill of expert fencers is, above all, evident when the gesture to perform is more complex and the uncertainty of the situation is greater (Nougier et al., 1990).

A previous study investigated cognitive processing in fencers by means of event-related potentials (ERPs). In particular, an acoustic discrimination task (Rossi et al., 1992) showed that both RTs and N2 and P3 component latencies were shorter in fencers, suggesting an increased speed in decision-making. Recently, studies have investigated brain activity during visual go/no-go tasks requiring action inhibition (Di Russo et al., 2006; Rossi et al., 1992; Taddei et al., 2012; Zhang et al., 2015). Hence, Di Russo et al. (2006) demonstrated a larger N1 component in elite fencers, indicating a better modulation of visual attention. Moreover, larger N2 and P3 components in fencers compared to non-athletes suggested that fencers might differ in inhibitory functions. Taddei et al. (2012) compared fencers with non-athletes of different ages and confirmed that fencers were faster than non-athletes in the go/no-go task. Furthermore, the N1, the N2 and the No-goP3 components were larger in fencers than in non-athletes, indicating higher levels of visual attention and inhibitory processing. Zhang et al. (2015) confirmed the superior inhibition ability of fencers marked by faster RTs and enhanced N2 components. Chavan et al. (2015) showed that the above-normal inhibitory control in fencers depends on the reinforcement of frontal-basal structural connectivity. Gutiérrez-Davila et al. (2018) used the go/no-go paradigm in the study of specific fencing movements, taking into consideration the relationship between the appearance of the no-go signal and the suppression of the step forward-lunge movement Bianco et al. (2017) compared fencers and boxers recording ERPs during the execution of a go/no-go task. The results showed that the N1, N2, P3, and pP2 were greater for the fencers; likewise, the prefrontal negativity indicated by the pN was also greater for the fencers, indicating that their attentional control was more effective than that of the boxers. Overall, these data seem to highlight a greater efficiency of cognitive processes in fencers, in particular visual attention, inhibitory control and decisional processes.

Moran (2014) described three types of attention: concentration - the voluntary capacity to focus attention on one stimulus; selective attention - the ability to focus on one stimulus, eliminating distractions; divided attention - the capacity to focus on two or more stimuli and carry out two or more tasks simultaneously. Van Zomeren & Brouwer (1994) proposed a multi-component attentional model characterized by intensive and selective features. Examples of intensive aspects are alertness, the mental state when preparing a response to stimuli, and vigilance, prolonged attention on one or more types of information. Divided attention, the ability to perform multiple tasks simultaneously, focused attention, and the ability to direct attention to specific information represent examples of selective characteristics. For this study, Zimmermann & Fimm's (2012) test battery of attentional performance (TAP), version 2.3 was chosen. It has been applied mainly in a clinical setting (Zoccolotti et al., 2000), and has rarely been used in sports (Fontani et al., 2006). Four TAP battery tests were selected: alertness, optical vigilance for the intensive features, divided attention, and go/no-go for the selective features.

As a novelty, this study will compare a group of fencers and a group of swimmers, a discipline with limited cognitive commitment compared to fencing, and a group of non-athletes who do not practice sports at a competitive level. This information may help to determine differences between disciplines to know the inherent attentional characteristics that enhance each discipline in athletes. Moreover, a gender analysis will be conducted, which may unravel the keys to coaching athletes from different genders and shed light on practitioners' coaching strategies. Moreover, as there are discrepancies in the previous studies (Hülsdünker et al., 2016; Nakamoto & Mori, 2008; Voss et al., 2010), this study aimed to identify the attentional features of fencers, comparing them to non-athletes and swimmers, taking into account both intensive and selective aspects of attention. No hypothesis was established as previous studies did not report consensus in the results revealed.

Methodology

Participants

Three groups of participants were studied: thirty-seven fencers (20 female, 17 male), all of whom had practiced regularly on an average of three, two-hour training sessions a week, for at least eight years; twenty-one swimmers (10 female, 11 male) who had practiced regularly on an average of three to six, two-hour training sessions a week for at least eight years; thirty-two non-athletes (16 female, 16 male), none of whom had ever practiced any sport to competition level. The characteristics of the participants (sample size, mean age and standard deviation) are shown in Table 1.

Table 1. Participants characteristics

		Group			
		Fencers	**Swimmers**	**Non-Athletes**	**Total**
Gender	Female	20 (21.7 ±4.1)	10 (20.9 ±3.2)	16 (22.5 ±3.8)	46 (21.4 ±3.8)
	Male	17 (22.0 ±6.2)	11 (21.7 ±2.8)	16 (19.8 ±2.6)	44 (21.1 ±4.4)
	Total	37 (21.3 ±5.1)	21 (21.3 ±2.9)	32 (21.2 ±3.5)	90 (21.3 ±4.1)
Sample size (Mean age in years ±standard deviation), divided by group and gender					

Procedure and measures

After a full explanation of the procedures, which were approved by the local ethics committee (CAR 141/2022), participants provided written informed consent to participate in the study. The attentional tests, selected by the Test of Attentional Performance (TAP) 2.3 version (Zimmermann & Fimm, 2012), were administered using a computer by clicking the appropriate keys for the answers connected to the USB port. Participants were required to click a key as rapidly as possible using their dominant hand. Reaction Times (RTs) and errors (e.g., omissions - lack of response to target stimuli- and incorrect responses – responses to non-target stimuli) were recorded. Each participant received instructions and performed a practice test to confirm their comprehension of the task before them. The administration of the tests lasted approximately 60 minutes. Tests were presented in the following order: alertness, divided attention, go/no-go and vigilance.

In the alertness test, participants responded (with or without a warning signal) when a 2 cm. cross (x) appeared in the center of the computer screen. A total of eighty stimuli were presented, divided into 4 blocks of 20 (two with a warning signal and two without). The interval between the warning and the imperative stimulus varied randomly between 300 and 700 ms. RTs and the number of omissions were measured.

In the divided-attention test, participants responded to two simultaneous tasks, one visual and one acoustic. In the visual task, a series of regular matrices measuring 10 x 10 cm, consisting of sixteen points, each appearing on the screen for 2 seconds. A small cross (x) was randomly superimposed on seven of the sixteen points. The participant was required to click on a key whenever four crosses (x) formed a square. At the same time, in the acoustic task, the participant listened to a continuous and regular series of high (2000 Hz) and low (1000 Hz) sounds and, by pressing the key, was required to identify a variation in the sequence (i.e. the presentation of two low sounds or two high sounds consecutively). One hundred visual stimuli were administered (15 target and 85 non-target), and 200 acoustic stimuli, (15 target and 185 non-target). Reaction times, a number of omissions and false responses were recorded.

The go/no-go test examined the capacity to suppress a response in the presence of irrelevant stimuli, as well as examine the delay in responding during the selection of the stimulus. This task consisted of five stimuli of different patterned squares, 3 cm. by 3 cm. in dimension, which appeared on the screen in succession. Two of these patterned squares were target stimuli, and three were non-target stimuli. On the appearance of the target stimuli, the participants were to click a key, whereas, on the appearance of the non-target stimuli, they were to refrain; in total, there were 60 stimuli - 24 targets and 36 non-targets. RTs and the number of false responses were registered.

The vigilance test is a measure of sustained attention in conditions of monotony. In the version used in this task (optical), the stimulus was a bar of 0.3 x 3 cm. that oscillated regularly in the center of the screen (1.8 cm.); when the bar showed a larger oscillation (approx. 3.5 cm.) the subject was required to click the key as quickly as possible. The test lasted 15 min., and the target events were 15, one per minute. The parameters recorded were the RTs for correct answers and the number of omissions.

Data analysis

In the first analysis, the age of the participants was subjected to analysis of variance (ANOVA), considering the group (at three levels: fencers, swimmers and non-athletes) and gender (female and male) as factors to check any significant differences in the age of the participants.

A multivariate analysis of variance (MANOVA) was employed to test group differences on all the RT measures (alertness, divided attention, go/no-go, and vigilance), considering group (fencers, swimmers and non-athletes) and gender (female and male) as factors. The age variable was considered a covariate. To evaluate the significant main effect and interaction, the data relating to alertness with the presence of the warning signal, alertness with the absence of the warning signal, divided attention, go/no-go, and vigilance were subjected separately to univariate ANOVA, the group (fencers, swimmers and non-athletes) and gender (female and male) using as factors. The following dependent variables were considered: the median of the RTs for all tests, the omissions for alertness, divided attention and vigilance and the incorrect responses for divided attention and go/no-go. The age variable was considered a covariate. Regarding the divided attention test, due to the different range of responses (median RTs to visual stimuli = 789.5 ±117 ms, range 646-1244 ms; median RTs to acoustic stimuli = 509.5 ±85 ms, range 330-771 ms), the RTs relating to the visual and acoustic tasks were processed separately. To estimate the size of statistical effects, the partial eta-squared (η_p^2) was calculated. Post-hoc analyses were conducted using the Tukey HSD test. The overall alpha level was fixed at 0.05.

Results

Age. The analysis of age, as a dependent variable, did not show any significant statistical results. There were no differences in relation to age regarding group factor, gender factor or group x gender interaction.

Multivariate analysis. A MANOVA revealed a significant effect of group (Wilks' Lambda = .588, $F_{12, 156} = 3.9495$, $p<.0001$, $\eta_p^2 = .233$) and gender (Wilks' Lambda = .764, $F_{6, 78} = 4.02$, $p<.001$, $\eta_p^2 = .236$).

Univariate analysis - Alertness. In the *warning* condition, the group factor was significant ($F_{2, 83} = 3.63$, $p<.05$, $\eta_p^2 = .080$): post-hoc analyses indicated that the group of non-athletes (202 ±26 ms) showed higher RTs than swimmers (184 ±26 ms, $p<.05$), while fencers (200 ±25 ms) do not differ significantly from the other groups (fig. 1). The analyses conducted on omissions did not have any significant results.

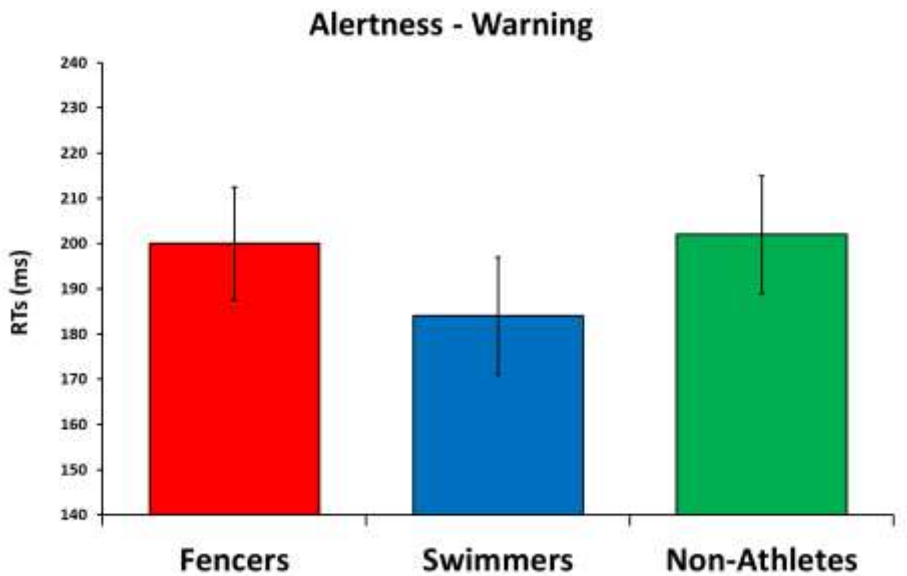

Figure 1. Alertness test: in the warning condition the group factor was significant; post hoc analyses indicated that non-athletes showed higher RTs than swimmers (p<.05). Fencers and swimmers do not differ from each other. Vertical bars denote standard deviation.

In the *no-warning* condition the group factor was significant ($F_{2, 83} = 6.43$, $p<.01$, $\eta_p^2 = .134$): the group of non-athletes (217 ±36 ms) showed higher RTs than swimmers (189 ±24 ms, $p<.005$), while fencers (204 ±24 ms) do not differ significantly from non-athletes and swimmers. The gender factor was also significant ($F_{1, 83} = 6.43$, $p<.01$, $\eta_p^2 = .081$): males (197 ±26) show faster RTs than females (213 ±32). Regarding the group x gender interaction ($F_{2, 83} = 3.56$, $p<.05$, $\eta_p^2 = .079$), non-athlete females (234 ±41) showed significantly higher RTs than male non-athletes (200 ±21, $p<.01$), male (186 ±29, $p<.001$) and female swimmers (193 ±17, $p<.01$) and male (201 ±28, $p<.01$) and female fencers (207 ±20, $p<.05$) (fig. 2). The analyses conducted on omissions did not have any significant results.

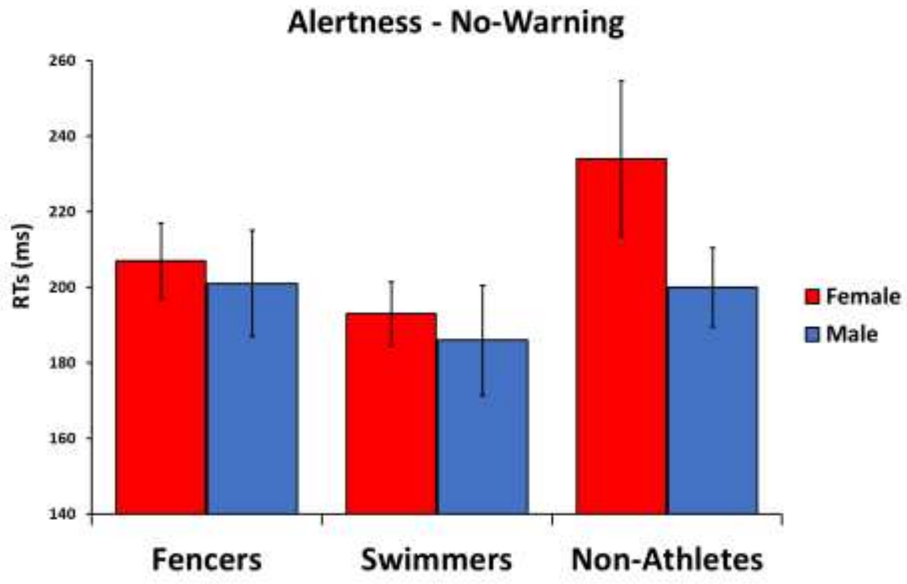

Figure 2. Alertness test: group x gender interaction was significant in the no-warning condition. Female non-athletes show higher RTs than all the other groups, which do not differ significantly from each other. Vertical bars denote standard deviation.

- *Divided attention.* The data recorded in the divided attention test were processed by separately analyzing the reaction times obtained in response to visual (squares) and acoustic (sounds) stimuli. For visual task RTs, the group factor was significant ($F_{2, 83} = 8.99$, $p<.001$, $\eta_p^2 = .178$). Fencers (745 ±75 ms) showed significantly faster RTs than non-athletes (852 ±141 ms, *p*<.001) and swimmers (823 ±97 ms, *p*<.05). Non-athletes and swimmers did not differ from each other (fig. 3).

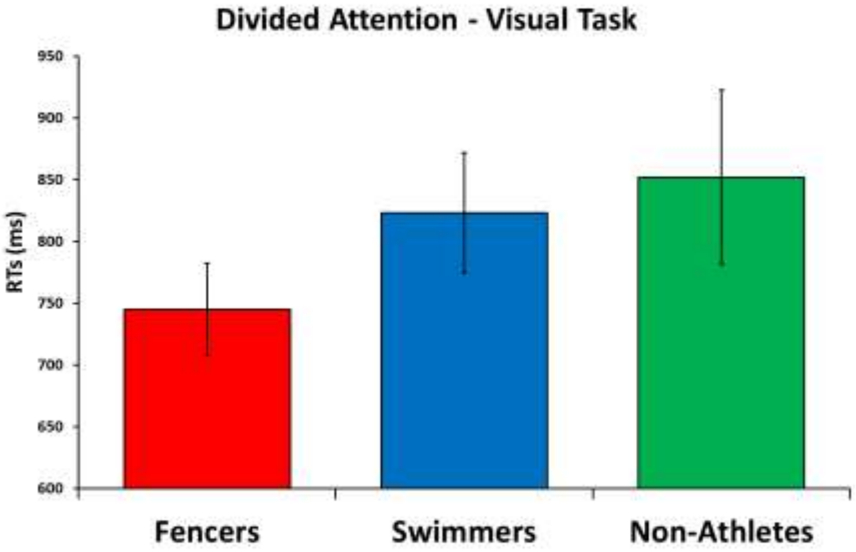

Figure 3. Divided attention (RTs): fencers are faster at responding to visual stimuli (squares) than swimmers and non-athletes. There are no differences between swimmers and non-athletes. The vertical bars represent the standard deviation.

Considering a number of omissions in visual task, significant differences emerged in relation to the group factor ($F_{2, 83}$=6.72, *p*<.01, η_p^2=.139). Fencers (.65 ±.89) showed fewer number of errors than non-athletes (1.94 ±1.86, *p*<.01). Swimmers (1.48 ±1.86) do not differ significantly from the other two groups (fig. 4).

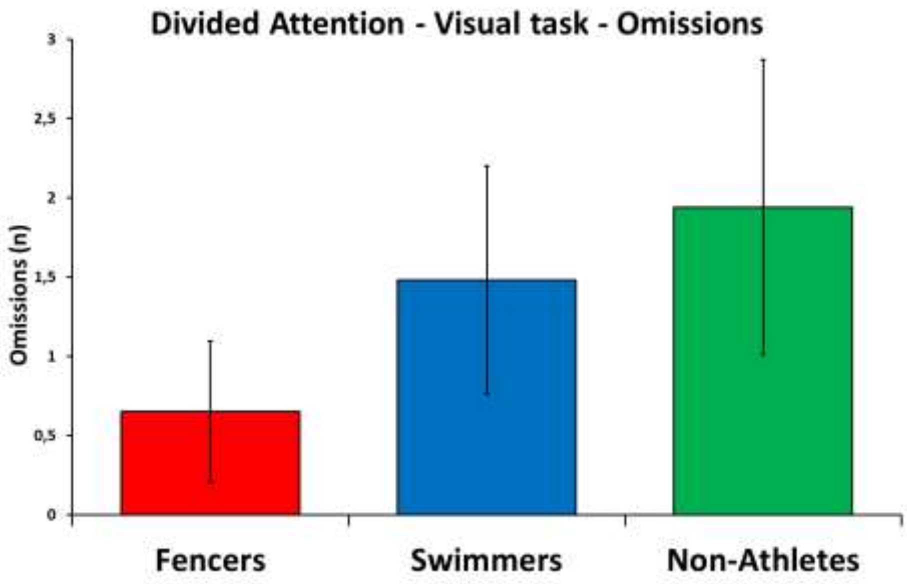

Figure 4. Divided attention (omissions): in the visual task, fencers are more accurate in response than non-athletes, while the latter do not differ significantly from swimmers. Vertical bars denote standard deviation.

Analysis of incorrect (false) responses showed no significant results. The analyses conducted on the recorded variables (RTs and errors) in the acoustic task did not show significant results.

- *Go/no-go*. Fencers are also faster in their responses in the go/no-go test (464 ±41 ms) compared to the other groups ($F_{2, 83} = 7.44$, $p<.005$, $\eta_p^2 = .152$). The post hoc analysis shows significant differences compared with the swimmers (503 ±54 ms, $p<.005$) and the non-athletes (513 ±67 ms, $p<.05$). There is no difference between non-athletes and swimmers (fig. 5). Analyses that considered errors in responses as dependent variables did not show any significant effects.

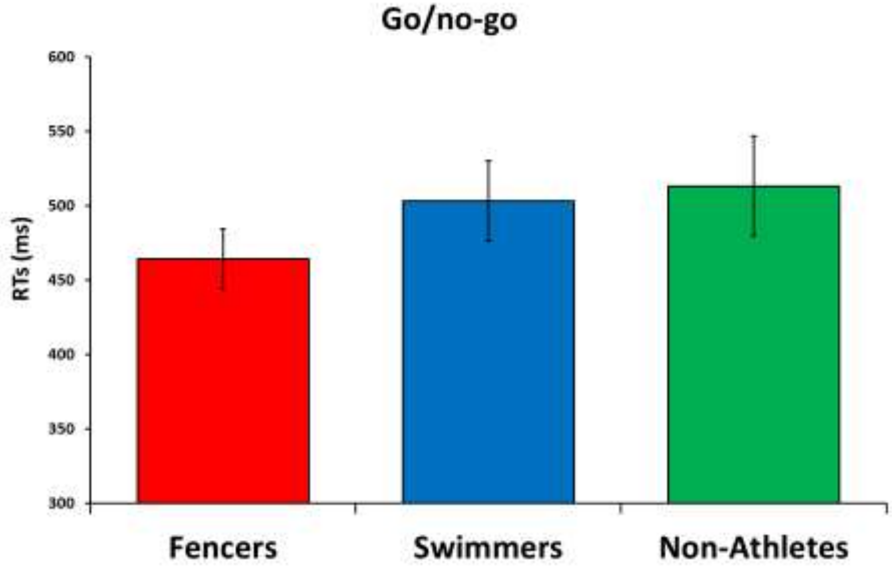

Figure 5. Fencers are faster than swimmers and non-athletes in the go/no-go test. There is no difference between swimmers and non-athletes. Vertical bars represent the standard deviation.

- *Vigilance*. Regarding the vigilance test, the gender factor was significant ($F_{1,\ 83}$ = 5.57, p<.05, η_p^2 = .063). Males (486 ±150 ms) were faster than females (572 ±167 ms) in their responses (fig. 6). There were no significant differences in the omissions.

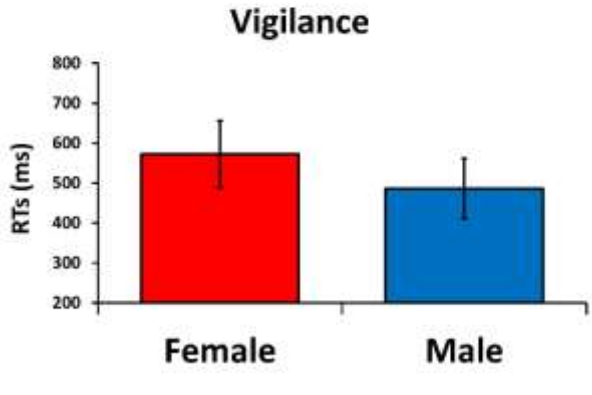

Figure 6. Vigilance: males are faster than females in the vigilance test responses. Vertical bars denote standard deviation.

Discussion and conclusions

This study aimed to identify the attentional features of fencers, comparing them to non-athletes and swimmers, taking into account both intensive and selective aspects of attention. Data presented by the literature in relation to athletes' reaction times do not always concur. Several authors maintain that athletes' reaction times cannot represent the differences in information processing since general stimuli are usually used in RT recordings. At the same time, the best performances by experts are the result of perceptive and decisional acquisitions in specific contexts (Nakamoto & Mori, 2008). On the contrary, other authors maintain that differences in sports activity are evident in laboratory tasks that do not employ sport-specific stimuli. Voss et al. (2010) carried out studies regarding the relationship between expertise in sport and various laboratory-tested cognitive measurements. Athletes who practised interceptive sports such as tennis, boxing and fencing showed better results.

Regarding our data, the RTs recorded in the alertness test (both in the warning and no-warning conditions) the results showed that swimmers are faster than non-athletes; fencers do not differ significantly from the other two groups. In addition, only in the no-warning condition our data showed a quicker response of males than females, which seems to depend on the group of female non-athletes; the analyses of group x gender interaction highlighted that females who do not practice any sport at a competitive level have slower RTs compared to all other participant groups. Several studies show RT differences between athletes and non-athletes. For example, results for practising baseball and basketball players (Nakamoto & Mori, 2008) and badminton (Hülsdünker et al., 2016) were faster than non-athletes in simple RTs. Fontani et al. (2006) found differences between practising athletes from diverse levels of karate and volleyball. With respect to fencers, our data fundamentally seem to concur with the results of previous simple RT studies that did not reveal differences between fencers and non-athletes. For example, in studies conducted by Di Russo et al. (2006) on top-level fencers, significant differences did not emerge in relation to responses recorded under "simple" conditions (simple RTs) compared with non-athletes. A study that used the same paradigm but with participants from different ages (young and middle-aged fencers and non-athletes) obtained similar results (Taddei et al., 2012). Besides, neither did Chan et al. (2011) find any differences between fencers and non-athletes in simple RTs.

Regarding gender differences, most of the studies presented in the literature state that males are faster than females in RTs (Der & Deary, 2006). However, Silvermann (2006) stated that male advantage in visual RT is diminishing. According to this author, this phenomenon is most likely due to the increase in the number of women who drive cars and who practice sports that require quick reactions. As such, it seems that these results make sense because if men and women are exposed to the same stimuli there is not difference by gender in time response. Our data seem to confirm this hypothesis since sportswomen, whether they are fencers or swimmers, their simple RTs do not differ from their male counterparts.

In the divided attention test, RTs recorded in visual and acoustic tasks are subject to separate statistical analyses. Fencers, in their responses to acoustic stimuli, do not seem different from those of swimmers and non-athletes. On the contrary, in the visual task, fencers showed greater speed than either swimmers or non-athletes. There were no statistical differences between swimmers and non-athletes. These data seem to confirm the importance of visual attention in fencing and in all sports disciplines, characterised by extremely fast visual motion and highly unpredictable temporal-spatial interaction (Azémar et al., 2008). In this regard, by registering the N1 component of ERPs (Event Related Potentials) during experimental tasks, diverse studies have highlighted the fundamental role that visual attention in sports discipline plays with the above characteristics. The N1 component appears in the relatively early stages of the elaboration of visual information (Hillyard & Anllo-Vento, 1998). The role of visual attention was highlighted through the recording of the N1, for example, in a group of table tennis players subjected to a test on the orienting of attention (Hung et al., 2004) and in badminton players undergoing a stop-signal task (Chen et al., 2019). In the case of fencers, various studies confirm that they show major levels of attention regarding visual stimuli, demonstrating greater N1 component, compared to both non-athletes (Di Russo et al., 2006; Taddei et al., 2012) and sportsmen and women of other disciplines (Bianco et al., 2017).

In the go/no go test, fencers differ significantly from non-athletes and swimmers; they are faster. The ability to inhibit a response seems to be one of the typical characteristics of fencing. While the RTs reaction might be regarded as an indication of basic efficiency processes such as the control of stimulus and a motor execution, the reaction time recorded in go/no-go tasks includes ulterior cognitive functions such as the identification of the stimulus and the choice of response (Nakamoto & Mori, 2008). Several authors maintain that faster reaction times in go/no-go tasks that use visual stimuli have been observed in sports characterised by quick decisions and inhibited responses (Nakamoto & Mori, 2008). Nakamoto & Mori (2008) have found faster responses among volleyball and basketball players compared to non-athletes. Wang et al. (2013), using a "stop signal" task, found that tennis players were more capable of inhibiting responses compared to swimmers and sedentary subjects. Tennis players show greater reaction times than the other two groups, which do not differ from each other, causing the authors to conclude that open-skill disciplines can positively determine inhibitory control in athletes. The literature related to this skill among fencers seems to confirm their greater ability to inhibit responses compared to non-athletes. This is demonstrated by their faster reaction times in go/no-go tasks (Bianco et al., 2017; Di Russo et al., 2006; Taddei et al., 2012; Zhang et al., 2015).

Electrophysiological data (ERPs registrations) also confirmed behavioural data (Bianco et al., 2017; Di Russo et al., 2006; Taddei et al., 2012; Zhang et al., 2015). Chan et al. (2011), using the same type of experimental paradigm without finding any differences in reaction times regarding non-fencers. Fencers with high levels of fitness are more accurate in carrying out tasks; they make fewer mistakes compared to non-athletes with the same fitness levels. The authors conclude that "aerobic fitness and sporting expertise are necessary in order to achieve good cognitive control". All in all, our data seem to confirm the superiority of fencers' inhibitory capacity. This ability is the basis of developing executive functions (Diamond, 2013), common to other open-skill sports (Gu et al., 2019; Koch & Krenn, 2021; Heilmann et al., 2022).

The term "vigilance" is often used as a synonym to express "sustained attention". While vigilance is a form of sustained attention characterised by monotonous situations and by rather long intervals (up to hours or minutes) and concerns temporal processes, sustained attention lasting for shorter periods (up to seconds or minutes) and concerns spatial processes (Memmert, 2009; Memmert et al., 2023). At the time of writing, it seems that there have been no research studies on this topic regarding these aspects of the practice of sport. Our data show that in this test, fencers do not show significant differences from the other groups. However, in relation to the gender factor, males are faster than females. Although there does not seem to be any research that has directly investigated this aspect of the attention on gender differences, our data seems to agree substantially with what has been reported in the literature on sustained attention (Kosinski, 2008; Riley et al., 2006).

As a limitation and a future direction, further research should confirm our findings, for example, by increasing the number of participants and taking other samples with different characteristics and from different historical periods. In addition, it would be interesting to consider, in further research, the differences within the specialities of fencing. The regulations that currently govern the specialities of Olympic fencing (foil, epee and sabre) involve significant differences in technique, tactics and strategy that are reflected, for example, in the duration of bouts (Tarragó et al., 2023). It would be interesting to evaluate whether these differences are associated with different attentional processes depending on the discipline practised.

From a pedagogical and educational point of view, this study has interesting implications, which can extend across both athletic and general learning environments. First, the demonstrated ability of fencers in selective and visual attention suggests that training regimens emphasizing these attentional capacities could be beneficial if implemented broadly within educational systems. Educational practitioners could design exercises mirroring the divided attention and go/no-go tasks used in the study, thereby helping students refine their ability to concentrate on essential stimuli while filtering out irrelevant distractions. Such training would be particularly advantageous in settings where students need to manage multiple tasks simultaneously, as in digital learning environments, fostering cognitive adaptability and resilience under pressure.

Moreover, the study highlights the importance of response inhibition, particularly through the go/no-go task, which underscores the potential value of including inhibitory control exercises within educational curricula. Enhanced inhibitory control, as observed in fencers, correlates with improved executive functions, such as decision-making and impulse control, critical skills for academic and personal success. By incorporating structured activities that encourage students to pause, evaluate, and respond selectively, educators can cultivate these skills in students, thereby fostering an environment that supports measured, thoughtful responses over impulsive reactions.

Additionally, the study's gender-based findings, where males showed faster reaction times than females in alertness and vigilance tasks, present an opportunity for educational programs to consider differentiated instructional strategies. Recognizing and adapting to diverse cognitive processing styles may enable educators to tailor attention-training exercises more effectively to individual needs, thus supporting a more inclusive learning environment. In practical terms, this might involve designing gender-sensitive or customized attentional drills, ensuring that students with varying cognitive profiles receive equitable support to reach their attentional potential.

From a broader educational policy perspective, the study suggests a need to prioritize and invest in developing cognitive training programs that extend beyond traditional rote memorization or passive learning techniques. Schools could benefit from a curriculum shift towards exercises that cultivate high-level attentional and inhibitory skills, taking inspiration from the rigorous cognitive demands observed in high-performance sports like fencing. Such an approach would not only improve students' academic performance but also equip them with essential life skills, including the capacity to handle stress and uncertainty.

In sum, the study on fencers' attentional characteristics underscores the value of integrating cognitive exercises that foster selective attention, multitasking, and inhibitory control within the educational framework. These findings advocate for a holistic educational model that addresses the cognitive development of students alongside academic learning, fostering well-rounded, resilient individuals capable of thriving in complex, rapidly evolving environments.

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