ORIGINAL ARTICLE

Visual perception strategies as a factor of importance for differentiating during fight the fencers in left-handed against the right-handed and during combat opponents with the same dominant hand

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Abstract

Background and Study Aim: Since visual perception plays an important role in fencing, it might differ between left- and right-handed performers, and perhaps giving the former some advantage over the latter. The purpose of this work is hypothesis that left- and right-handed foil fencers differ in terms of their perception strategies.

Material and Methods: We base our verification of this hypothesis on to compare the strategies the two groups of foil fencers (left-handed and right-handed) they use to evaluate actions taken by their opponents. Perception strategies of 18 left- and 21 right-handed professional foil fencers were compared using an eye-tracker to analyse their eye movements during preliminary actions by the participants. The actions were performed over a minute in two variants: during a fight with a right- and left-handed opponent. We used an eye-tracker to monitor eye movements during duels. We also recorded and analysed visual fixations, that is, the maintaining of the gaze at particular visual targets (the range of gaze directions and locations, by comparing the pupil centre and the location of the corneal reflection, which is done against the background), while a static image recorded by the camera placed in the device – used as a reference image in data analysis.

Results: Left- and right-handed foil fencers chose different strategies. When left-handed ones are fighting against right-handed opponents, they pay more attention to the guard, the armed hand, and the upper torso than to the lower torso. But when they are opposing left-handed opponents, they pay more attention to the upper torso than to the foil. Opposing right-handed opponents, right-handed foil fencers focus more on the opponent's upper torso than on the foil; opposing left-handed fencers, however, they focus more on the armed hand than on the lower torso and the foil.

Conclusions: From the study, it follows that left- and right-handed fencers choose different perception strategies. Therefore, to be effective, a fencer's strategy should take into account the opponent's handedness. Thus, fencing trainers should develop personalised fighting strategies for their trainees, in order to help them effectively oppose right- and left-handed opponents.

Keywords: combat sports • contact sport • handedness • lateralisation • perception • performance

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Fencing – *noun* the art or practice of fighting with slender swords, formerly in combat, now as a competitive sport [53].

Foil – is the one of the three modern fencing weapons (foil, épée, and sabre), each a separate event.

Lateral – *adjective* **1.** further away from the midline of the body **2.** referring to one side of the body [53].

Athlete – *noun* **1.** someone who has the abilities necessary for participating in physical exercise, especially in competitive games and races **2.** a competitor in track or field events [53].

Player – *noun* someone taking part in a sport or game [53].

Performance – *noun* the level at which a player or athlete is carrying out their activity, either in relation to others or in relation to personal goals or standards [53]

Perception – *noun* the process of using the senses to acquire information about the surrounding environment or situation [53].

Cognitive – *adjective* relating to the process of acquiring knowledge by the use of reasoning, intuition or perception [53].

Neurological – *adjective* relating to neurology [53].

Neurology – *noun* the scientific study of the nervous system and its diseases [53].

Tactics – *plural noun* the art of finding and implementing means to achieve immediate or short-term aims [53].

Contact sport – *noun* any sport in which physical contact between players is an integral part of the game, e.g. boxing, rugby or taekwondo [53].

INTRODUCTION

Left-handedness in sports has long intrigued scientists and trainers. In some sports disciplines it does not make much of a difference – but what about fencing? It is a one-sided sport in which two athletes fight each other using a weapon held in one hand. Their handedness, thus, seems to matter [1].

Lateralisation manifests in a better performance of one limb over the other, but also in the greater tendency of a person to use it. Right-handed people prefer using their right hands while left-handed ones their left hands. Most of the population is right-handed, with only about 10% of left-handed people [2-4].

Lateralisation is largely genetically determined, although the gene or genes responsible for it have not been fully recognised [5, 6]. According to some theories, not only genetically but also environmental, cultural, and mixed factors play important roles in left-handedness [7-9]. Since right-handed people often prefer using their right hands for complex tasks, standardised questionnaires [10] and their modifications [11] use this preference as the indicator of a dominant hand.

Professional fencing exhibits an interesting phenomenon: many elite fencers are left-handed, including winners and leading athletes of world-class competitions and championships [12-14]. As many as half of the twenty-four medallists of the 2006 World Fencing Championships were left-handed [15]. This phenomenon also appears in the ranking of the World Fencing Federation [16]. Compared with the above-mentioned small share of left-handers in the population, these numbers clearly show that left-handers are over-represented among elite fencers. It does suggest that left-handedness gives a fencer some advantage over right-handed ones.

The advantage of left-handed fencers is usually explained by their much smaller share in the population, thanks to which they often confront right-handed athletes and so can develop more effective fighting strategies against them [15]. This effect is nothing new, as it was known among the sixteenth-century fencing masters; today's masters also know and exploit it, and they call it the "frequency-dependent" effect [14].

Harris [14] suggested that left-handed fencers have specific neurologically conditioned skills or capabilities. That left-handedness can help an athlete has been observed in other combat sports, such as judo [17], wrestling [18], boxing [19], and taekwondo [20]. Wright [21] suggested that the overrepresentation of left-handed athletes among the sports elite resulted from their frequent opportunities to practice against right-handed athletes. The latter, however, seldom can practice against opposite-handed opponents, making it difficult for them to develop the ability to correctly predict the actions of left-handed opponents.

Wood and Aggleton [7] suggest that left-handed athletes have an innate neurological advantage over right-handed ones, regardless of the nature of the sports discipline. According to Hagemann [22], this advantage in contact sports results from certain tactical decisions made automatically during a fight against a right-handed opponent. Movement control by a left-handed athlete is better when facing a right-handed than a left-handed opponent.

This discovery underlines that visual experience plays a crucial role in the perception of human movements. Loffing [23] pointed out an interesting phenomenon: the advantage of left-handed athletes vividly demonstrates in sports with a high time pressure, such as baseball, cricket, and table tennis. Analysing gaze behaviour during penalties in handball, Loffing et al [24] concluded that the goalkeepers' better predicted penalties performed by right- than left-handed players. According to the authors, this phenomenon did not have to result from misalignment in gaze behaviour; the differences in accuracy could be due to the differences in the goalkeepers' abilities to pick up and interpret visual information that left- and right-handed players provide. Despite that, the authors found no differences in gaze measures (i.e., the number of fixations, overall and final fixation duration, and time-course of horizontal and vertical fixation deviation) of goalkeepers opposing players from the two groups.

Does the above reasoning also apply to fencing? It might, since the sense of sight provides athletes with about 80% of all the information they perceive, and the method of obtaining information from the environment influences the effectiveness of technical and tactical activities in fencing. In addition, an appropriate perceptual strategy allows a fencer to correctly choose the distance from the opponent and predict his or her actions [25].

Perception and attention are two different cognitive processes. Perception is the process of creating representations based on information received mainly from the sense organs. Attention aims to reduce the excess of such information, a mechanism that – due to the limitations of the cognitive system – controls the processes of receiving and processing information so as to avoid the dangerous effects of cognitive overcharging [26]. It is attention that allows one to choose various sensory stimuli and use them while acquiring skills and developing appropriate behavioural habits [27].

The basic process of collecting information from the external environment is visual perception [28, 29]. In contact sports, an athlete's anticipation of the opponent's actions and the time of reaction to these actions depend on his or her abilities of visual perception [28, 30, 31]. Quite likely, it is the ability to quickly recognise the opponent's actions rather than the reaction time that differentiates fencers representing varying sport levels [32]. In sport, thus, visual control appears to be a key skill in the movement process [33].

To study information pick-up during duels, in fencing in particular, analysing eye movements can help. This can be done using an eye-tracker, a special device that registers the eye movements of athletes and the images they see. Such complex information allows one to determine their areas of visual interest, visual strategies, and visual fixations. In sports requiring accuracy – such as golf, archery, and billiards – visual stimuli are crucial for the effectiveness of actions [29]. They are crucial also in fencing, a sports discipline of high accuracy. Theories stating that left-handed people have a neurofunctional advantage over right-handed ones are still awaiting explanation, which calls for the use of modern methodological approaches [1]. One such novel approach can be to study visual perception strategies used by the two groups of foil fencers (left-handed and right-handed). We take this approach, assuming that vision plays a crucial role in the human sensory system [28, 34].

The purpose of this work is hypothesis that left- and right-handed foil fencers differ in terms of their perception strategies.

MATERIAL AND METHODS

We base our verification of this hypothesis on to compare the strategies the two groups of foil fencers (left-handed and right-handed) they use to evaluate actions taken by their opponents.

we used an eye-tracker to monitor eye movements during duels. We also recorded and analysed visual fixations, that is, the maintaining of the gaze at particular visual targets. The eye-tracker, thus, allows to determine the range of gaze directions and locations, by comparing the pupil centre and the location of the corneal reflection, which is done against the background (a static image recorded by the camera placed in the device), used as a reference image in data analysis.

Participants

Thirty-nine professional Polish foil fencers (20 women and 19 men) took part in the study. They represented at least an average skill level, having been training for over seven years. Eighteen of them declared left- while twenty-one right-handedness. Some of the participants were medallists of world, European, and Polish championships in various age categories.

The research project was positively evaluated by the Bioethical Commission of the Poznan University of Medical Sciences. All the participants had current medical certificates entitling them to participate in fencing competitions. They, or the legal guardians of under-age ones, gave written consents to participate in the study.

Research procedure

The research procedure consisted of preliminary actions by the participants. Similar to a real duel, the actions were performed during one minute in two variants: during a fight with a right- and left-handed opponent. The study was conducted in a well-lit specialised fencing hall, during the Polish University Championships 2017 and the Polish Junior Cup 2017 (until 20 years old).

During the study, the participants were wearing eye-tracking glasses (Eye tracking Glasses ETG 2w Natural Gaze 60Hz – SensoMotoric Instruments). It is equipped with a high resolution (1280×960) camera and automatically compensates for parallax errors, thus allowing one to obtain accurate results at any distance without the need for manual adjusting the settings. The glasses enabled us to study on which parts of the opponents' body the participants focused their gaze during the fight. Based on such data, we compared the participants' behaviour in terms of this phenomenon when opposing a right- and a left-handed opponent.

Before the study, each participant learned the research procedure and underwent a three-point calibration.

Reference images

We prepared two reference images: for a right-handed opponent and for a left-handed one. We marked on them so-called areas of interest (AOIs), given below. They were selected during consultancy with the coach of the Poland Women's Olympic Team in foil fencing and several other experienced coaches. The AOIs were as follows: **G** guard; **F** opponent's foil (blade and tip); FR athlete's foil; **M** mask; **AH** armed; hand; **UH** unarmed hand; **LT** lower torso; **UT** upper torso; **T** torso (both lower and upper); **FT** front thigh; **BT** back thigh; **FL** front leg; BL back leg; **FF** front foot; **BF** back foot (Figure 1).

Dependent variables

The statistical analyses were conducted for the following four eye-tracking indicators:

• dwell time (%): the time devoted to an AOI, expressed as percentages,

• average fixation: the average length of fixation on an AOI,

• glance count: the number of glances on an AOI,

• fixation count: the number of fixations on an AOI.

All these indicators were determined independently per participant and AOI.

Figure 1. The schematic reference image for a right-handed opponent, showing the areas of interest (AOIs) studied.

Statistical analysis

We analysed the data using software from SensoMotoric Instruments – BeGaze™ and the Mobile Video Analysis Software, with which we also prepared the reference images. All the AOIs were subjected to preliminary data analysis, which used the number of participants who looked at an area and the number of these glances. It helped us select the most important AOIs, which we then used in the final statistical analysis.

To compare left- and right-handed foil fencers in terms of these indicators, three-way analysis of variance (ANOVA) was applied, taking into account AOI and the opponent's handedness. The ANOVA model included the following factors:

• the fencer's handedness, a between-group factor with two levels: left- and right-handed;

• AOI, a within-group factor with five levels: guard, the opponent's foil, the armed hand, the lower torso, and the upper torso;

• the opponent's handedness, a within-group factor with two levels: left- and right-handed.

Since the indicators did not follow the normal distribution, we transformed them using the natural transformation. In case the sphericity assumption was violated, we used the Greenhouse-Geisser epsilon correction. For pairwise comparisons of the main and interaction effects, we applied the Bonferroni test.

RESULTS

Dwell time (%)

The main effects of the fencer's (F (1.37) = 0.12, p>0.05) and the opponent's (F(1.37) = 0.19, p>0.05) handedness were non-significant, unlike the main effect of AOI (F(2.10, 77.86) = 8.46, p<0.001, epsilon = 0.53, partial η^2 = 0.19). Fencers spent significantly shorter time looking at the foil than at the guard (p<0.001), the armed hand (p<0.001), and the upper torso (p<0.001). They also spent significantly longer time looking at the armed hand than at the lower torso (p<0.05).

All the two-way interaction effects were non-significant: between AOI and the fencer's handedness (F(2.10, 77.86) = 0.73, p>0.05, epsilon = 0.53), between the opponent's and the fencer's handedness (F(1.37) = 0.61, p>0.05), and between AOI and the opponent's handedness (F(3.01, 111.22) = 1.64, p>0.05, epsilon = 0.75).

The three-way interaction effect (between AOI, the fencer's handedness, and the opponents handedness), however, was significant (F(3.01, 111.22) = 11.33, p<0.001, epsilon=0.75, partial η^2 = 0.23; Figure 2). Left-handed fencers opposing right-handed ones (Figure 2, the left panel, the dotted line) spent significantly longer time looking at the guard and the armed hand than at the lower torso (p<0.001), and they spent longer time looking at the upper than at the lower torso (p<0.05). Left-handed fencers opposing left-handed fencers (Figure 2, the left panel, the solid line) chose a different strategy: they spent significantly longer time looking at the upper torso than at the foil (p<0.001) and significantly longer time looking at the guard than at the foil (p<0.05). Left-handed fencers spent significantly longer time looking at the lower torso when they were opposing a left-handed opponent than when opposing a right-handed one (the effect of marginal significance, with p = 0.05548).

In right-handed fencers, the analysis showed a different relationship between AOI and the opponent's handedness. When fighting against a right-handed opponent (Figure 2, the right panel, the dotted line), they spent significantly more time looking at the upper torso than at the foil (p<0.05). But when fighting a left-handed opponent (Figure 2, the right panel, the solid line), they spent more time looking at the armed

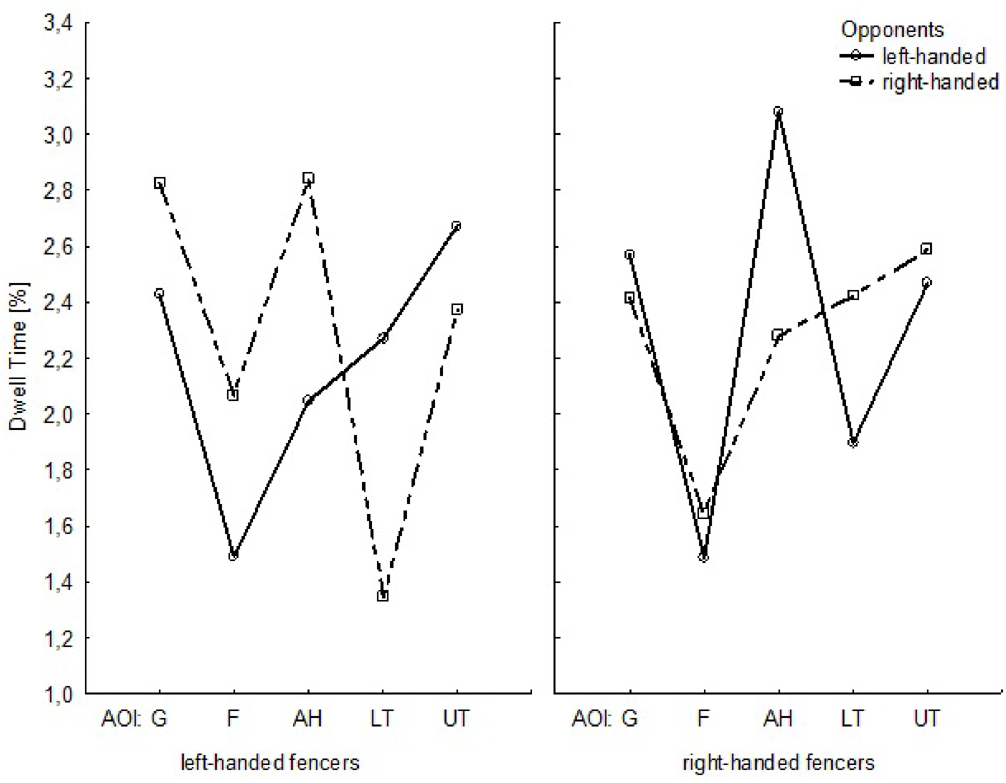

Figure 2. Dwell time against AOI and the opponent's handedness for left- and right-handed fencers.

hand than at the lower torso ($p<0.001$) and the foil ($p<0.001$). They also spent more time looking at the upper torso and guard than at the foil ($p<0.01$).

Average Fixation

None of the main effects was significant at the 0.05 level (the fencer's handedness: $F(1.37) = 0.45$, $p>0.05$; the opponent's handedness: $F(1.37) = 2.25$, $p>0.05$; AOI: $F(2.79, 103.13)=0.78$, $p>0.05$, epsilon = 0.70). In addition, in terms of average fixation, the two-way interactions between AOI and the fencer's handedness ($F(4, 148) = 0.60$, $p>0.05$), the opponent's handedness and the fencer's handedness ($F(1.37) = 1.03$, $p>0.05$), and AOI and the opponent's handedness ($F(4.148) = 1.70$, $p>0.05$).

Like in the case of dwell time, the three-way interaction effect between AOI, the fencer's handedness, and the opponents handedness was significant ($F(4,148)=3.58$, $p<0.01$, partial $\eta^2=0.09$; Figure 3). Fighting with right-handed opponents, left-handed fencers (Figure 3, the left panel, the dotted line) fixated significantly longer on the armed hand and the guard than on the lower torso ($p<0.05$). Fighting with left-handed opponents (Figure 3, the left panel, the solid line), however, all AOIs had similar average fixation times.

Fighting with right- and left-handed opponents, right-handed fencers (Figure 3, the right panel) had similar fixation times for all the AOIs studied.

Glance Count

The main effects of the fencer's ($F(1,37) = 0.36$, $p>0.05$) and the opponent's handedness ($F(1,37) = 0.11$, $p>0.05$) were non-significant. AOI's main effect, however, was significant ($F(2.18, 80.75) = 9.13$, $p<0.001$, epsilon = 0.55, partial $\eta^2 = 0.20$). Fencers glanced at the guard more often than at the foil ($p<0.001$) and the lower torso ($p<0.05$), and at the armed hand more often than at the foil ($p<0.001$) and the lower torso ($p<0.01$). In addition, they glanced more often at the upper torso than at the foil ($p<0.01$).

AOI and the fencer's handedness ($F(2.18, 80.75) = 0.82$, $p>0.05$, epsilon = 0.55) as well as the fencer's and the opponent's handedness ($F(1,37) = 0.21$, $p>0.05$) did not significantly interact – but AOI and the opponent's handedness did ($F(4,148) = 3.07$, $p<0.05$, partial

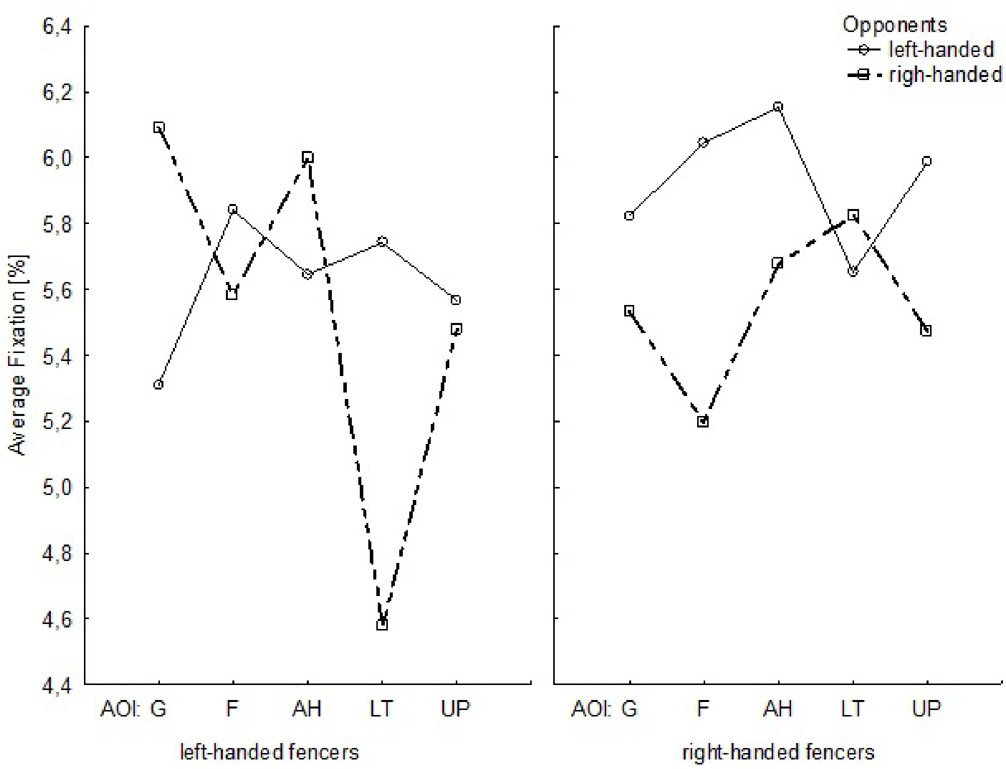

Figure 3. Average fixation against AOI and the opponent's handedness for left- and right-handed fencers.

η^2 = 0.08). Left- and right-handed fencers, however, differed in terms of this interaction effect, owing to a significant three-way interaction between AOI, the fencer's handedness, and the opponent's handedness (F(4.148) = 10.99, p<0.001, partial η^2 = 0.23; Figure 4).

Fighting with right-handed opponents, left-handed fencers (Figure 4, the left panel, the dotted line) glanced more often at the guard and the armed hand than they did at the lower torso (p<0.001). They also glanced more often at the upper than at the lower torso (p<0.01). Fighting with left-handed opponents, however, left-handed fencers (Figure 4, the left panel, the solid line) directed marginally more of their glances to the upper torso than to the foil (p = 0.0648). They also glanced more often at the lower torso when fighting with left- than with right-handed opponents (p<0.01; Figure 4, the left panel).

Right-handed fencers fighting with right-handed opponents (Figure 4, the right panel, the dotted line) glanced significantly more often at the guard than at the foil (p<0.01). When fighting left-handed fencers (Figure 4, the right panel, the solid line), however, they glanced more often at the armed hand than they did at the lower torso (p<0.001) and the foil (p<0.001). They also directed more glances to the guard than to the foil (p<0.001).

Fixation Count

The main effects of the fencer's (F(1,37) = 0.01, p>0.05) and the opponent's handedness (F(1,37) = 0.13, p>0.05) were non-significant, but AOI's main effect was significant (F(2.08, 77.1)=8.82, p<0.001, epsilon = 0.52, partial η^2 = 0.19). Fencers fixated significantly less on the foil than on the guard (p<0.001), the armed hand (p<0.001), and the upper torso (p<0.001). They also fixated more on the upper torso and the armed hand than on the lower torso (p<0.05).

All the two-way interactions were non-significant: between AOI and the fencer's (F(2.08,77.1) = 0.74, p>0.05), the opponent's handedness and the fencer's handedness (F(1.37) = 0.22, p>0.05), and AOI and the opponent's handedness (F(3.03, 112.17) = 1.79, p>0.05, epsilon = 0.76). Nonetheless, the three-way interaction between the factors studied was significant (F(3.03, 112,17) = 11.69, p<0.001, epsilon = 0.76, partial η^2 = 0.24). Fighting with right-handed opponents, left-handed fencers

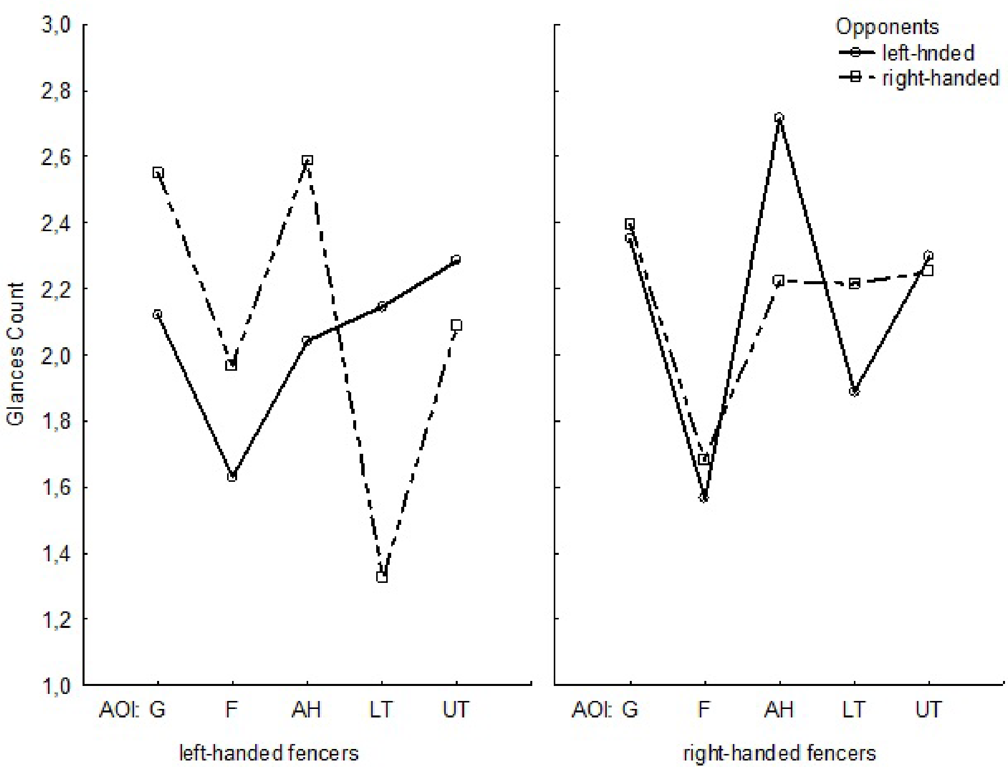

Figure 4. Glance count against AOI and the opponent's handedness for left- and right-handed fencers.

(Figure 5, the left panel, the dotted line) fixated more on the guard ($p<0.001$), the armed hand ($p<0.001$), and the upper torso ($p<0.01$) than they did on the lower torso. Fighting with left-handed opponents, however, left-handed fencers (Figure 5, the left panel, the solid line) fixated more on the upper torso than on the foil ($p<0.01$). What is more, left-handed fencers fixated more on the lower torso when fighting with left- than with right-handed opponents ($p<0.01$).

Right-handed fencers fighting with right-handed opponents (Figure 5, the right panel, the dotted line), however, fixated more on the upper torso than on the foil ($p<0.01$). But when they were fighting with left-handed opponents (Figure 5, the right panel, the solid line), they fixated more on the armed hand than on the foil ($p<0.001$) and the lower torso ($p<0.001$); in addition, they fixates less on the foil than on the guard ($p<0.001$) and the upper torso ($p<0.01$).

DISCUSSION

The research showed differences between left- and right-handed foil fencers in terms of visual perception. For example, left-handed foil fencers fighting against right-handed opponents generally pay more attention to the guard, the armed hand, and the upper torso than to the lower torso. But when they are opposing left-handed opponents, they pay more attention to the upper torso than to the foil. Right-handed foil fencers opposing right-handed ones focus more on the opponent's upper torso than on the foil, but opposing left-handed fencers, they focus more on the armed hand than on the lower torso and the foil.

These observations show that fighting against a fencer of the opposite handedness, foil fencers tend to pay more attention to the areas of the armed arm. Fighting against an opponent of the same handedness, however, a fencer pays more attention to the upper torso and less to the weapon.

The ability to locate and identify relevant visual information is essential to achieving a high level in sports. Williams et al. [35] state that athletes obtain relevant information by central and peripheral vision. They also stress that visual search behaviours in sports are dynamically shaped by unique constraints imposed by the task, the environment, and

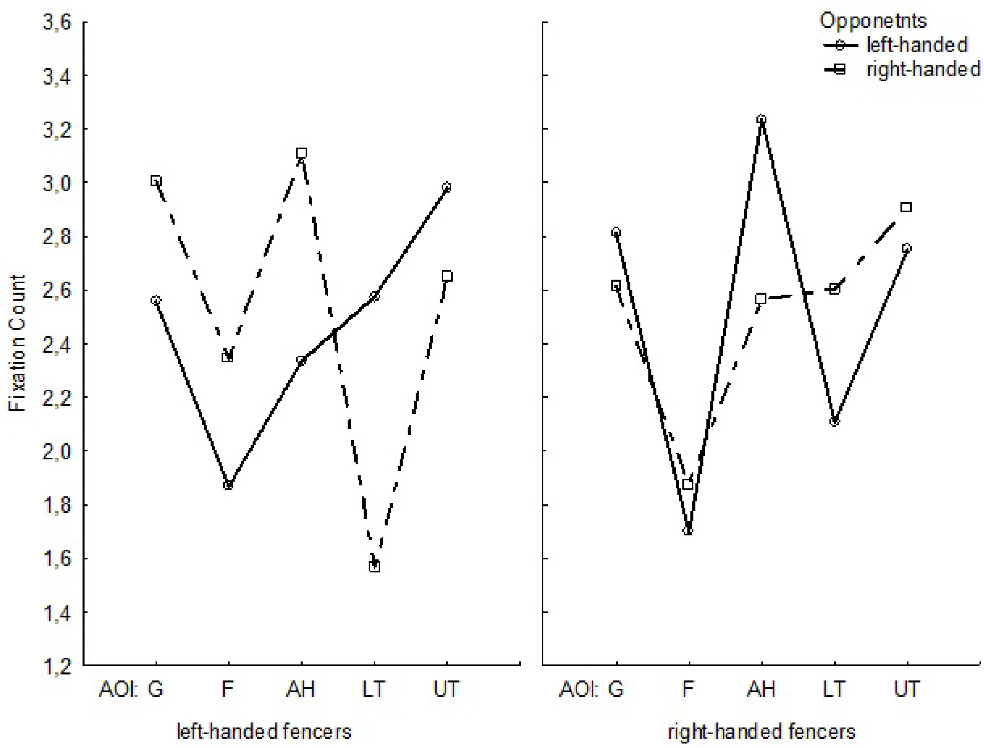

Figure 5. Fixation count against AOI and the opponent's handedness for left- and right-handed fencers.

the individual characteristics of the athlete. Such constraints appear at a particular moment during competition.

Vickers [36] shared similar thoughts. Motor behaviour of any type requires the brain to process various information, but at one time it can process its limited amount – and so it must be carefully selected. Athletes thus have to constantly choose from among a large pool of information, selecting elements to focus on and a method for processing them. A performer can direct his or her gaze to only one location at one time, and must select the key information from spatially complex environments – and this is usually done under severe time constraints.

Mann et al. [37] attempted to quantify differences in terms of perceptual-cognitive expertise between expert and non-expert performers. To this end, the authors used various measures, such as response accuracy, response time, the number of visual fixations, the duration of visual fixation, and the quiet eye period. The results for response accuracy and response time indicated that experts better picked up perceptual clues than did non-experts. The two groups also differed in terms of visual search behaviours: experts used fewer fixations of longer duration. Witkowski et al. [16] also suggested that duels between right- and left-handed fencers were atypical in terms of visual behaviour.

Differences in how an opponent is perceived depending on his or her skill level have been studied in rocket sports [34,38-41], shooting [29, 42], and team games [33, 43-47].

Hagemann et al. [48] studied eye movements of fencers who were observing fencing attacks, in order to test whether these movements reflected their actual information pick-up. The study included fifteen top-ranking fencers (called experts), fifteen advanced fencers, and thirty-two sport students. The participants observed on a computer screen 405 fencing attacks and were asked to predict their target areas. The eye movement records showed that the two groups of advanced fencers fixated more on the torso and the opponent's weapon; expert fencers focused their gaze mainly on the upper torso. The authors did it by comparing these results with the results obtained using temporary and spatial occlusion techniques. Fencers (from both groups) showed stronger foveal fixation on an opponent's torso and weapon, but top-ranking fencers fixated mainly on the upper torso. When this area was occluded, participants shifted eye movements to the neighbouring body regions. Hagemann et al. [48] concluded that gaze behaviour did not necessarily represent information pick-up but rather served as a control function.

Shelton and Kumar [49] compared auditory and visual stimuli – both being important for improving an athlete's performance – in terms of simple reaction time. The mean visual reaction time was shorter (around 331 milliseconds) than the mean auditory reaction time (around 284 milliseconds). Men had quicker reaction times – both auditory and visual – than women had.

Since most fencers are right-handed, we can assume that opposing a left-handed one creates atypical fighting conditions. This calls for a different position of the armed hand and a different fencing position; thus, a different perception strategy needs to be used in the fight. Another interesting challenge occurs during a fight between two left-handed fencers: they have to choose yet another perception strategy to deal with this infrequent situation.

Fencing strategy mainly on recommendations regarding either the use of left-handed fencers or the skill of fighting left-handed fencing with right-handed opponents (of which there are more in the population) would be a defective operation. Although in the literature of science and sport medicine works dedicated to fencing are rare, the latest research results concerning of body composition [50], the ability to correct an on-going action [51] and anthropometry, physical performance, motor coordination [52] create the basis for building a multifactorial strategy. This is the intention of our recommendations (supplementing already available scientific knowledge) formulated below in the section Conclusions.

CONCLUSIONS

From the study, it follows that the opponent's handedness matters. Thus, we should forget about developing, for a given foil fencer, a universal strategy, which would be reflected in generally the same strategy employed against left- and right-handed opponents. Our research suggests this would a strategical mistake: personalised strategies should be developed against opponents of different handedness – because they are likely to choose different strategies themselves.

Visual perception undoubtedly plays a crucial role in both competition and training. Individual training offers an opportunity to generalise individualised perception strategies against right- and left-handed opponents. To this aim, the trainer can simulate both scenarios by changing the weapon-handling hand. To choose the optimum strategy against a particular opponent, the fencer has to consider various elements, and one of them – a crucial one – is the hand in which the opponent holds his or her weapon. So high a share of left-handed fencers among the elite suggests that they constitute quite a problem for right-handed ones, who have problems with adapting their fighting strategy to such a fight.

Thus, research on the visual perception of fencers can help build theoretical and applied knowledge on fighting strategies in fencing. This, in turn, can help train fencers to fight with both right- and left-handed opponents. Both these strategies need to be practised: that against right-handed opponents, because most fights involve them; and that against left-handed opponents, because few fights involve them, seldom creating opportunities to both fight against and practice successful fighting strategies against them.

HIGHLIGHTS

Left- and right-handed foil fencers pay attention to different parts of their elements body and arm, so they adopt different visual perception strategies during fights.

Thus, a strategy against an opponent should take into account his or her handedness.

Irrespective of a fencer's handedness, his or her training should involve practice against both left- and right-handed opponents.

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