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Effect of presentation order and misinformation on anticipation skills in expert soccer players

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The aim of this work is to study the effect of order of presentation and misinformation on aniticipation skills in soccer. Forty expert soccer players participated in the study. A total of 105 videos were presented for the first experiment (effect of order presentation), while 45 videos were used for the second experiment (effect of misinformation). After the stimulus disappears, the participant is asked to anticipate as quickly as possible by pressing a button. The order of presentation and misinformation showed an overall effect on response accuracy, response time and response efficiency ($p < 0.0001$). Despite the expertise of the soccer players, it does not present an advantage during the anticipation. The manipulation of the unexpected situational probability is sufficient to degrade the anticipation performance. This manipulation could have influenced the strategy used by the brain in calculating the probabilities of the events and/or the neural model of anticipation in sport.

KEY WORDS: Cognition, Anticipation, Order of presentation, Misinformation, Temporal occlusion

Introduction

Anticipation skill is considered as one of the important and critical parameters to sport performance, particularly in high-pressure or 'clutch' situations (Shim et al., 2005 ; Williams & Jackson, 2019). For instance, to predict the opponent's intention, the player needs to select the pertinent information from the environment (placement, speed, trajectory) or the adversary (body placement, visual orientation, segmental displacement) and process it in order to understand the forthcoming movement (Russo & Ottoboni, 2019). In soccer, environment is complex and uncertainty is very important in view of the different possibilities for opponent's

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intentions. Indeed, in football, the number of players is 22, and each player presents a level of uncertainty in relation to these intentions, whether of the opponent or the partner. Therefore, this enormous set of possibilities offered by partners and adversaries complicates the environment and makes anticipating the sequel a complex task. Therefore, the player needs a perceptual-cognitive skill allowing him to solve this spatial-temporal problem in order to make the right decision as quickly as possible (Williams & Jackson, 2019). Perceptual cognitive skills are the abilities to use several senses, such as vision, to identify and recognize information in the environment. This information is then integrated with existing knowledge to make decisions and take appropriate actions (Roca et al., 2013). Several cognitive processes that underlie anticipation are involved, such as attention, visual discrimination, memorization, and information processing (Afonso et al., 2012). The source of information could be kinematic or non-kinematic information (Loffing & Cañal-Bruland, 2017). Non-kinematic information relies on the context or situation. Anticipation ability is influenced by non-kinematic or situation probability in sport domain (Schläppi-Lienhard & Hossner, 2015). Loffing and Cañal-Bruland (2017) considers that game score, opponent position and the sequences of consecutive actions, in tennis, can influence the anticipation outcomes. In addition, this ability using probability of situation or context, to anticipate opponent's intentions, is more developed in expert players. The relationship between the order of appearance of stimuli and situational probability is not yet clear and studied.

Many factors can influence the situational probability like the opponent's court position (Loffing et al., 2016) and game scores (Farrow & Reid, 2012). Other factors, such as the action preferences of opponents, can be more complex (Mann et al., 2014). Their research aimed to study the effect of exposure to the action preferences of opponent on the anticipation ability (Mann et al., 2014). Two groups of skilled handball goalkeepers were asked to anticipate the direction of penalty. One group was trained on situational probability with action preferences of opponents. The second group non-trained and just viewed players who threw equally to all directions. In the trained group, the anticipation performance was improved if only the opponent continued to bias their throws towards their preferred direction. Information about action preferences improves anticipation ability but it is possible to be disadvantageous when the result is not consistent with the probable output. Anticipation ability using situational probability is not a simple process and it is necessary to studying how contextual information can influenced and how detect this effect to optimize anticipation (Cañal-Bruland & Mann, 2015).

To better understand the effect of situational probability on anticipation skill, some researchers have manipulated context-specific information. For example, McRobert et al. (2011) tested the effect of this manipulation on per-

ceptual-cognitive processes. 10 skilled and 10 less-skilled cricket batters were asked to respond to video simulations of opponents bowling a cricket ball in two conditions (high and low contextual information). Skilled players in high context (viewing opponent multiple times) reduced their mean fixation time. Also, for all batters performance has been improved with altered thought processes in the high context. The authors concluded that the context (dynamic, time-constrained task) influences performance and the search for relevant information (McRobert et al., 2011). Another study (Jackson et al., 2020) aimed to combine the effect of contextual and kinematic sources of information on anticipation 30 male soccer players (15 High-skilled) asked to judge whether the actor would take the ball to their left or right (12 blocks of 12 trials). The chance of the actor taking the ball to the left or right would be indicated on the screen before each block (50/50, 67/33 (or 33/67), or 83/17 (or 17/83)). This study showed that outcome probability information impairs skilled detection of deceptive intention. The results highlighted that situational probability information might harm anticipation because deceptive actions become 'super-deceptive' when aligned with observer expectations ((Jackson et al., 2020).

Among the complex ability in anticipation is to differentiate between genuine and deceptive intentions (Williams & Jackson, 2019). The literature has shown a differentiation in using information to discriminate between genuine and deceptive intentions in skilled vs. less-skilled performers. This visual search strategy involves the simultaneous selection of information from multiple sources (Cañal-Bruland et al., 2011; Huys et al., 2009; Loffing & Hagemann, 2014). Loffing and Hagemann (2014) considered that players are assumed to rely on both kinematic and contextual cues to anticipate future events. Sometimes, the kinematic information presents a risk and disadvantage for the anticipation because the visual information does not always allow understanding the opponent intention and therefore causes inefficient responses (Jackson et al., 2006). Jackson et al. (2018) are interested to the ability to differentiate genuine and deceptive actions using a spatial and temporal occlusion tests. Forty-eight female football players divided in two groups (High-skilled and low-skilled) participated in the study and asked to judge whether the player would take the ball to the left or right of the screen with verbal response (left or right). The results indicated that low-skilled players exhibited a greater bias towards judging actions as genuine. In addition, it is suggested that information from the lower and upper body was sufficient for differentiating genuine and deceptive actions. Another study manipulated sports garments to examine the ability to disguise and deceive action outcomes in anticipation judgments task (Smeeton et al., 2018). The main results revealed that disguise garments have a greater impact on high-

er-skilled anticipators compared to lower-skilled ones. This study highlighted that disguise removed the anticipation advantage.

In soccer, the probability of opponent intention is high uncertain. The situational probability is very variable because the number of possible scenarios is uncountable. Among the points not mentioned in previous research is the order of appearance of the opponent's intentions. Previous studies used a counterbalanced order for all experiments. However, the opponent can vary this order in a real context to overtake his opponent. We can question on how an order of presentation of stimuli can influence anticipation? Also a second factor that can influence the anticipation is the false intention by another (misinformation). Misinformation is considered as the misleading information, which can alter memory (Cuperus et al., 2016). For this study, misinformation is used to test whether the misleading information can alter the anticipation process by the presentation of false information that does not exist in the videos presented. This misinformation could be related to situational probability. Indeed, the subject should anticipate among several situations, with a withdrawn situation, and therefore a false situation, which would influence the processing of information and the whole bottom-up process.

This article aimed to study the effect of order of presentation (first experience) and misinformation (second experience) on anticipation skills in soccer expert players. These two parameters, which are always present in collective or individual sports, make it possible to influence and increase the uncertainty of the events coming from the adversary. Indeed, when the order of appearance is not controllable, the possible responses of the adversary require additional time at the information processing level. Thus, in situations of time pressure, the athletes use a risky strategy, which favors speed over precision that makes it possible to increase errors. We hypothesized that the manipulation of the order and misinformation will affect the anticipation accuracy. The random order will present less response accuracy than the manipulated order and the misinformation conditions.

Method

Participants

Forty expert soccer players voluntarily participated in the study. This group is characterized by a mean and standard deviation of age 21.66 ± 2.1 years. The participants were randomly divided into 4 groups (10 players per group). Inclusion criteria: 1) to have a minimum of 10 years of soccer experience, 2) to have normal or corrected vision, 3) to be between 18 and 25 years old. Non-inclusion criteria: 1) have psychological problems, 2) have problems related to the ear or vision.

Experimental stimuli and measured variables

Experimental Stimuli. One hundred five videos were selected from the men's soccer games and presented to the subjects. The 105 videos consisted of 35 passing, 35 keeping, and 35 shooting 60 Videos for the first experiment and 45 videos for the second experiment. No video was presented twice for each subject. To measure anticipation, a temporal occlusion test was performed. Occlusion consists of presenting the 3 sec before the intention. Indeed, the three seconds precede the opponent's decision and the subject must anticipate the opponent's intention before three seconds. For the realization of the experiment, the videos are prepared in advance using Open Shot Video Editor software on a LENOVO laptop. After a 1 sec fixation window, each video was presented for 3 sec and followed by a 10 sec response window (Figure 1). A video projector, which connected to LENOVO laptop, was used to display visual stimuli on a white mat screen 1 m × 1.4 m in size.

Fig. 1. - Presentation of the experimental stimulus.

Independent variables:

The order of presentation (First experiment): For each group, there is an order of presentation. Group 1: Passing-Keeping-Shooting, Group 2: Keeping-Shooting-Passing and Group number 3: Shooting-Passing-Keeping.

Misinformation (Second experiment): There are three false information in this experiment, which are: "Shooting" for group 1, "Keeping" for group 2 and "Passing" for group 3. False information for group 1 "Shooting", i.e. subject are asked to anticipate whether the stimulus presents the intention Passing, Keeping or Shooting when the stimuli presented do not contain intentions Shooting, but only Keeping and Passing. False information for group 2 " Keeping ", i.e. subject are asked to anticipate whether the stimulus presents the intention Passing, Keeping or Shooting when the stimuli presented do not contain intentions Keeping, but only Passing and Shooting. False information for group 3 " Passing ", i.e. subject are asked to anticipate whether the stimulus presents the intention Passing, Keeping or Shooting when the stimuli presented do not contain intentions Passing, but only Keeping and Shooting. Group Radom order presents all three intentions: Passing-Keeping-Shooting.

Dependent variables:

Response Accuracy (RA): is the number of correct responses expressed as a percentage.

Response Time (RT): is the time between the presentation of a stimulus and the beginning of the response. *Response Efficiency (RE)*: it is a ratio between the response relevance and the response time (see 2.4).

Procedure

The four groups performed two experiments in counterbalanced order between the first (effect of order) and the second experience (effect of misinformation) with a 10-minute rest time between the two tests to avoid the effect of fatigue and mental load. The subjects are informed about the steps of the experiment and a familiarization session was performed after signing an informed consent from each subject. The familiarization session is composed of three repetitions for each experiment. The subject was asked to sit on an adjustable chair in front of a table with a height of 1 meter and facing a computer (type LENOVO PENTIUM brightness of 0. 5cd/m). The distance between the subject's eyes and the computer screen is 50 cm. The writing hand is placed on the keyboard and the other is placed on the knee (standard condition for all subjects).

The participant looks at the screen where a black fixation point appears for 1 second followed by a 3-second video that presents the stimulus and a 10-second window for the response. After the stimulus disappears for 3 seconds, the participant is asked to verbally respond "Passing" or "Keeping" or "Shooting" as quickly as possible by pressing a button. As soon as his response is recorded, he can resume the experiment and start the next stimulus by pressing the button.

Experiment 1. This experiment focuses on the effect of stimulus onset order. Group 1 had a block consisting of 20 "Passing" stimuli followed by 20 "Keeping" stimuli followed by 20 "Shooting" stimuli. Group 2 had a block composed of 20 "Keeping" stimuli followed by 20 "Shooting" stimuli followed by 20 "Passing" stimuli. Group 3 had a block of 20 "Shooting" stimuli followed by 20 "Passing" stimuli followed by 20 "Keeping" stimuli. Group number 4, the control group had 60 randomly presented videos.

Experiment 2. In this experiment we are interested in studying the effect of misinformation. Same procedure as experiment 1 but the video will be composed of 30 stimuli that are randomly distributed. The participant will choose a response among three intentions in which there are two true intentions and one missing intention (the false information). The stimuli in group 1 contain 15 "Passing" and 15 "Keeping" intentions and the false information is "Shooting". The stimuli in group number 2 contain 15 "Passing" and 15 "Shooting" stimuli and the false information is "Keeping". The stimuli of group number 3 contain 15 "Shooting" and 15 "Keeping" stimuli and the false information is "Passing". The stimuli of the control group (4) contain 10 "Passing" stimuli, 10 "Shooting" stimuli and 10 "Keeping" stimuli.

Statistics

After testing the normality of the data distribution by Shapiro's test, parametric tests, ANOVA with repeated measures and Tukey's post hoc were performed. Effect sizes were reported as partial eta squared (η_p^2). The probability level is set at .05. All tests are realized using software Statistica 10 (Statsoft ©). Anticipation efficiency is calculated via the following equation:

$$\text{Efficiency} = \frac{(\text{Z score Accurary} - \text{Z score Time})}{\sqrt{2}}$$

Results

Effect of presentation order

Response Accuracy. The figure 2 shows the effect of stimulus presentation order on the percentage of correct response. The order of presentation showed an overall effect with $F_{(3, 36)} = 5.9$, $p < 0.01$, $\eta_p^2 = 0.33$. The results were as follows: group 1 (56 ± 4.5%), group 2 (44.3 ± 6. 14%), group 3 (41.1 ± 16.7%), and group random order (55.8 ± 7.7%). Post hoc analysis showed a difference in the percentage of correct response between group 1 and group 3 with $p < 0.05$ and between group 3 and group random order with $p < 0.05$ (Figure 2).

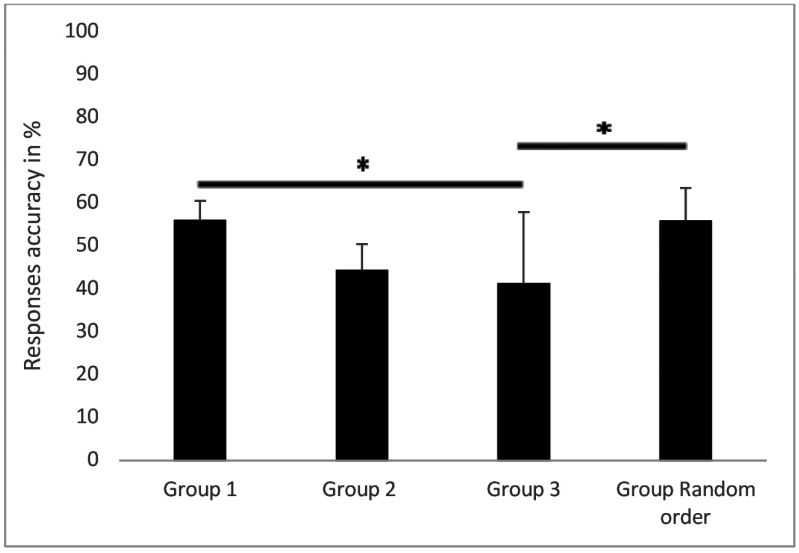

Fig. 2. - Effect of presentation order on response accuracy.
Note * = $p < 0.05$.

Response Time. Figure 3 shows the effect of stimulus presentation order on response time. The order of presentation showed an overall effect with $F_{(3,36)} = 3.1$, $p < 0.05$, $\eta_p^2 = 0.2$. The results were as follows: group 1 (660 ± 226.5 ms), group 2 (825 ± 234.2 ms), group 3 (918.6 ± 240.9 ms), and control group with (617.3 ± 295.6 ms). Post hoc analysis showed that there was a significant difference in RT between group 3 and the control group with $p < 0.05$.

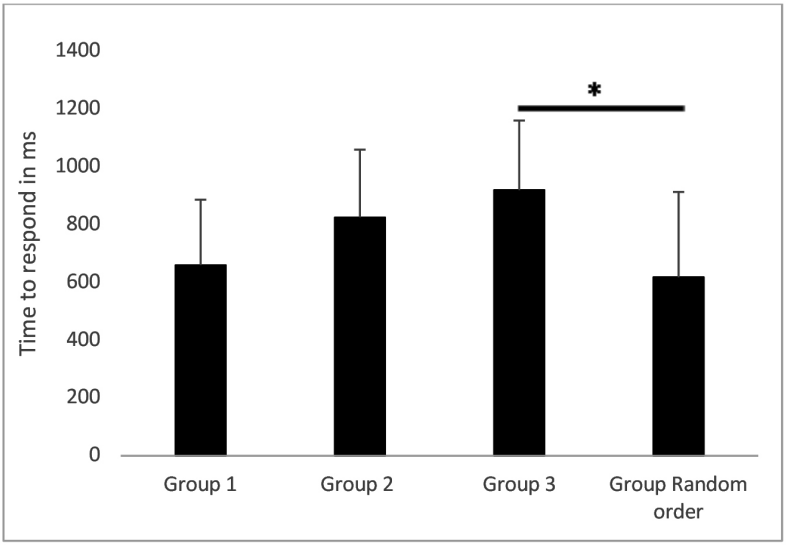

Fig. 3. - Effect of presentation order on response time.
Note * = $p < 0.05$.

Response efficiency. The presentation order influenced response efficiency in all 4 groups ($F_{(3, 36)} = 9.7$, $p < 0.0001$, $\eta_p^2 = 0.44$). Better efficiency was observed in group 1 (0.83 ± 0.38) and group random order (0.87 ± 0.44) superior to group 2 (-0.11 ± 0.47) with $p < 0.05$ and group 3 (-0.42 ± 1.1) with $p < 0.01$ (Figure 4).

Effect of misinformation

Response Accuracy. Figure 5 shows the effect of misinformation on the percentage of correct response. The results showed an overall effect with

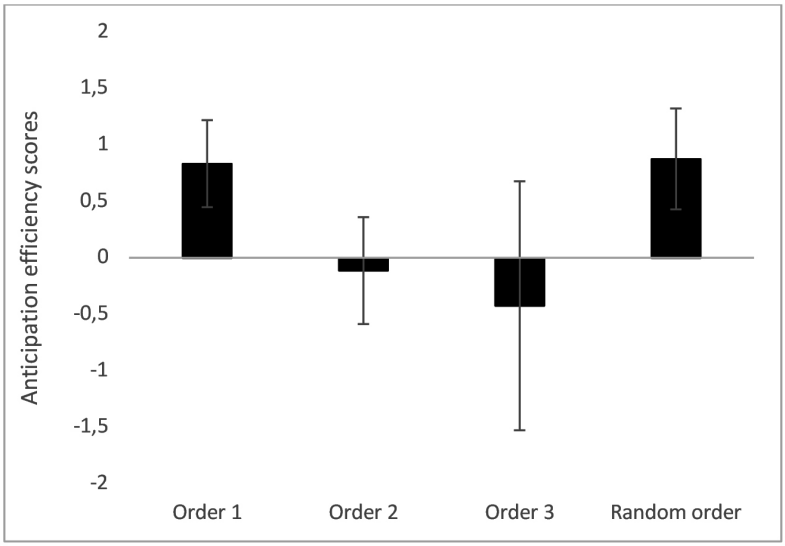

Fig. 4. - Effect of presentation order on the response efficiency.
Note * = p < 0.05.

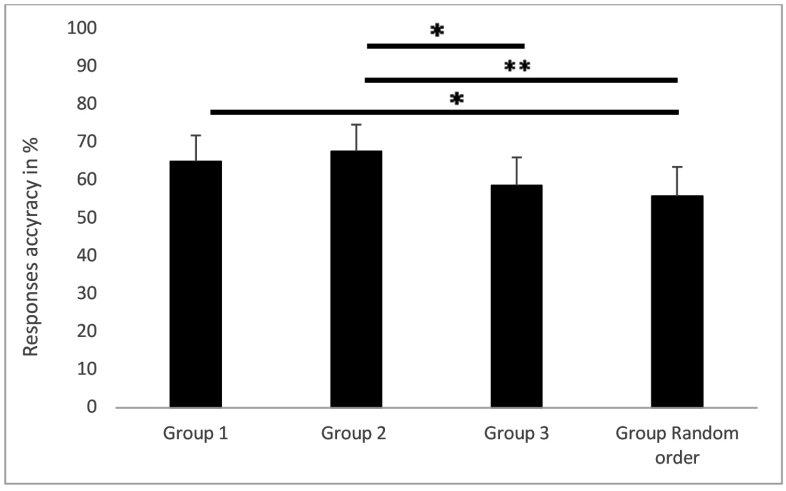

Fig. 5. - Effect of misinformation on response accuracy.
Note * = *p* < 0. 05. ** = *p* < 0. 01.

$F_{(3, 36)} = 5.67$, $p < 0.01$, $\eta_p^2 = 0.32$. The results were as follows: group 1 (65 ± 6.8%), group 2 (67.6 ± 7%), group 3 (58.6 ± 7.4%) and control group (55.8 ± 7.7%). Post-hoc comparisons showed a significant difference between group 1 and group random order with $p < 0.05$. Thus, between group 2 and group 3 with $p < 0.05$ and finally between group 2 and group random order with $p < 0.01$.

Response Time. The figure 6 shows the results of the effect of misinformation on response time. An overall effect was shown with $F_{(3, 36)} = 13.1$, $p < 0.001$, $\eta_p^2 = 0.52$. The results were as follows: group 1 shows better performance (371 ± 129 ms), group 2 (595 ± 137 ms), group 3 (968 ± 248 ms) and the control group (617 ± 295 ms). Post hoc analysis showed that there was a highly significant difference in response time with $p < 0.001$ between group 1 and 3, between group 2 and 3 and between group 3 and the control group with $p < 0.01$.

Response Efficiency. Misinformation significantly influenced anticipatory efficiency in all four groups ($F_{(3, 36)} = 12.62$, $p < 0.0001$, $\eta_p^2 = 0.51$). Better efficiency was observed in group 1 (1 ± 0. 55) and group 2 (0. 9 ± 0. 55) su-

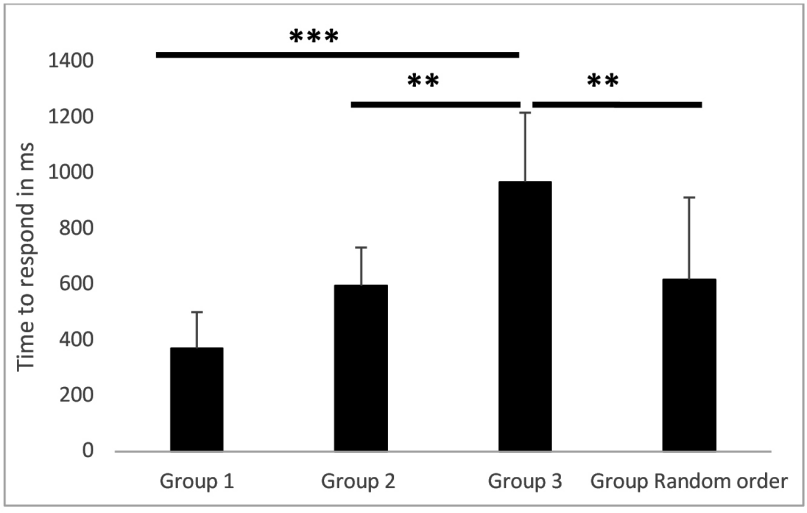

Fig. 6. - Effect of misinformation on response time.
Note ** = $p < 0.01$. *** = $p < 0.001$.

perior to group 3(-0. 46± 0. 87) with $p < 0.001$ and group random order (-0. 16±0. 59) with $p < 0.01$ (Figure 7).

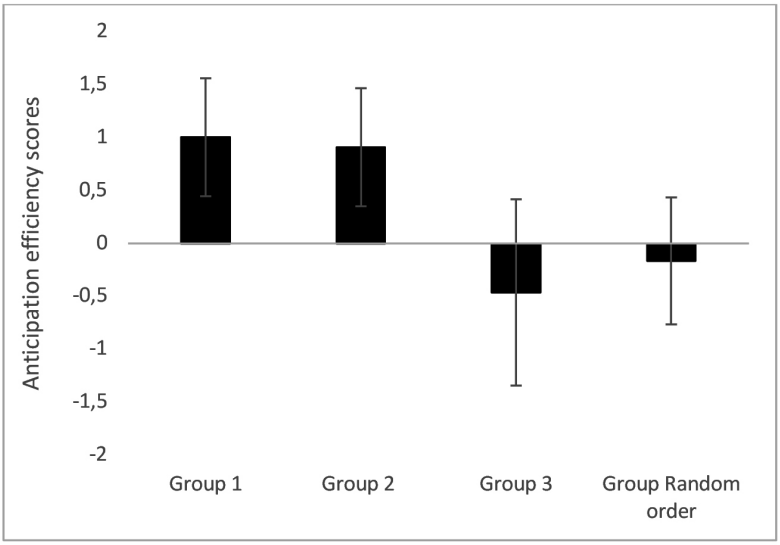

Fig. 7. - Effect of misinformation on the response efficiency.

Discussion

The purpose of this research paper was to investigate the effect of order of presentation and misinformation on anticipation skill in expert soccer players. The data obtained in the first experiment (effect of order of presentation) and the second experiment (effect of misinformation) showed his influence on the time and accuracy of anticipation.

Our results confirm the conclusions of Smeeton et al. (2018) which showed that experts are more affected by manipulation and who do not have an advantage in anticipation. This order effect could be explained by a change in situational probability that differs according to changes in the order of appearance of stimuli. The subject is accustomed to a random order or an adversary-specific order, which facilitates the processing of information, especially among experts. On the other hand, for this work, a specific order characterized by the repetition of the same intentions in different videos clearly showed the limit of the subjects in their capacities to anticipate the intentions of the adversary. Indeed, experts take advantage of their skills in

pick-up of information from the environment (Abernethy et al., 2001) which makes it easier to anticipate the opponent's intention and move to the right place at the right time. Information pick-up is influenced by information from the environment, the Bottom-Up process and the Top-Down process based on situational probability. The Bottom-Up process is characterized by taking relevant information only from the environment, such as the placement and movement of the adversary. On the other hand, the Top-Down process is based on the knowledge already stored in memory concerning the opponent such as the techniques used, the motor preferences which characterize him, the strong and weak points. Indeed, the situational probability in team sports could be influenced by the information of the environment but also by the pre-existing knowledge about the opponent and the course of the scenarios. So manipulating the order of presentation, this probability does not present the same logic of having random stimuli, but with a block order. Indeed, in soccer, often the possibilities of attacks present a great uncertainty and the opponent always tries to surprise his opponent. The results highlight the limit of expertise with the manipulation of the order of information in the environment. Abernethy et al. (2001) explained the advantage of experts over novices in a sport anticipation task such as squash by the advantage in pick-up of information from the pre-contact kinematics in movement pattern and the apparently superior nature of the event probability information. Williams et al. (2011) suggested that experts' anticipation of the unfolding of a scenario is based on an understanding of the probabilities of producing an event in a given context. It is therefore possible that the understanding of situational probability has been influenced by an order of presentation that causes different situational probabilities.

McRobert et al. (2011) showed that all batters improved performance and altered thought processes in the high context compared to low context. It was explained by a change in the visual search strategy for relevant information when engaging in a dynamic, time-constrained task. Our results do not suggest a change in the visual search strategy because the groups are independent, the subjects are naive to the purpose of the study, and there was no training in the experimental conditions. Kordning and Wolpert (2004) mentioned that human sensors in tennis provide imperfect information about the ball's velocity and we can only estimate it. The proposed solution is to combine information from multiple sources. Kordning and Wolpert assumed that the human brain uses a form of Bayesian strategy based on the statistical distribution of the probability of events. Therefore our results influenced by the manipulation of order and misinformation could be due to an effect of this strategy used by the brain in calculating the probabilities of the events.

Limits and perspectives

Although the study clearly highlights the effect of manipulating situational probability on anticipation skill, some clarification on how this is influenced at the subcortical level will be needed. Bishop et al. (2013) carried out an FMRI to study the neural bases for anticipation Skill in soccer. He showed a greater activation of cortical and subcortical structures involved in executive function and oculomotor control in high-skill than low-skill participants. Bishop et al. highlighted the existence of neural model of anticipation in sport. Therefore, it would be interesting to study how the manipulation of the situational probability influences the neural model of anticipation in sport. In addition, given the limit of the expertise observed during the anticipation, it is important to train the anticipation under conditions of manipulation of the order of presentation and misinformation.

Conclusion

The purpose of this research paper was to investigate the effect of order of presentation and misinformation on anticipation skill in expert soccer players. The data obtained in the first experiment (effect of order of presentation) and the second experiment (effect of misinformation) showed an influence on the time and accuracy of anticipation. Despite the expertise of the soccer players, it does not present an advantage during the anticipation. The manipulation of the unexpected situational probability (order of presentation and misinformation) is sufficient to degrade the anticipation performance. This manipulation could have influenced the strategy used by the brain in calculating the probabilities of the events and/or the neural model of anticipation in sport. It would be interesting to consider the training in anticipation based on the manipulation of the order of presentation and misinformation. This training could help develop visual search and information processing strategies to minimize errors and optimize anticipation in situations where situational probability is manipulated.

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