PSYCHOPHYSICAL STUDY OF EXPERTISE PERCEPTION OF DECEPTIVE MOTION IN RUGBY

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Abstract

This study investigated expertise perception of rugby players who attempted to predict the directional changes of opponents running toward them. The opponents' actions included sidesteps, which are often used by rugby players to feign an intention to move in one direction or another. Using video clips of those actions as stimuli, we conducted experiments to measure reaction times and anticipation accuracy of experienced and novice rugby players. The results indicated that the experienced players were less accurate than the novices when anticipating the directional changes without sidesteps, whereas the players were more accurate when the opponent's action included a sidestep, suggesting that experienced players would be more likely to assume that a deceptive action would be used.

Evidence for the expertise perception of sport players has been accumulated in sport perception research. Compared with novices and less skilled players, skilled players are superior at detecting, remembering, and making proper judgments regarding the sport they specialize in (Williams, Davids, & Williams, 1999). Expertise perception helps the players overcome spatiotemporal constraints imposed on them and, as a result, facilitates their performance. It is also demonstrated that their expertise perception can have detrimental effects on performance in other situations (Seya & Mori, 2007).

Particularly, superior anticipation of skilled players is well documented in literature. Skilled players are faster and more accurate than their non-skilled counterparts in anticipating activities, such as ball direction and opponent's action, by reading physical cues (Abernethy, 1990; Williams et al., 1999). The experimental paradigms typically used to examine a player's anticipation are occlusion tasks, where spatial and/or temporal information in the visual presentations of simulated plays is systematically varied, in order to identify critical sources of information for successful anticipation (for details, see Experiment 2 below).

In this study, we investigated a player's anticipation of deceptive motion. Deception is involved in a variety of sports and plays an important part in high-level competition. Concealing intention and misleading an opponent give an athlete an advantage. Such an advantage may be no longer than 100 msec in time or half a meter in distance; however, they will permit an expert player to hit, shoot, pass, or escape. Naturally, an opponent will attempt to counter deception and observe cues to determine whether actions are intended to deceive.

Despite the ubiquity and importance of deception in sports, only recently has perception of deceptive action been investigated. Sebanz & Shiffrar (2009) showed that expert basketball players were better than novices and performed above chance level at discriminating feigned from actual passes when watching videos and point-light displays of such actions. In a study directly relevant to the present research, Jackson, Warren, & Abernethy (2006) investigated the effects of a sidestep on the perception of rugby players attempting to tackle opponent players running toward them with balls. To avoid being tackled, a runner will sidestep to his left or right before running round the tackling players in the opposite direction. Jackson et al. (2006) videotaped rugby players running toward a camera and taking either a sidestep or no step, and they presented the films to expert rugby players and novices in a temporal occlusion task in which the films were cut off at various temporal points and the observers were asked to determine the direction in which the player would run. The results showed that judgment accuracy was higher for no-sidestep stimuli than for sidestep (deception) stimuli. While the expert players were not any more accurate than the novices for the no-sidestep stimuli, the experts were more accurate for the sidestep stimuli, suggesting that they were less susceptible to deceptive motions than the novices.

The present study extends the work of Jackson et al. (2006) in the following important respects. First, we included two-sidestep stimuli, in which a model player took two steps before changing direction (e.g., taking a step first to the left and next to the right before finally running to the left). In rugby games, two sidesteps are often used with one sidestep (the sidestep in Jackson et al., 2006) and no step. Second, the stimuli were presented in a real image size on a screen, whereas Jackson et al. (2006) used a 17-inch monitor to present the stimuli. Third, we conducted experiments with a reaction time (RT) task, in which the participants were instructed to determine the model player's running direction as fast and accurately as possible, as well as the temporal and the spatial occlusion tasks. We expected these changes to increase the ecological validity of our experiments and help us identify the manner in which expert rugby players would detect and react to deceptive actions. Due to space limitations, this paper deals only with the RT and spatial occlusion tasks.

Experiment 1: RT Task

Method

Ten collegiate rugby players and 10 novices (mean ages, 23.2 ± 1.1 years and 22.3 ± 0.5 years, respectively) participated. The players had played rugby for a mean of 9.0 ± 2.0 years, with five of them having competed at the national level. The novices had no prior rugby-training experience but possessed basic knowledge of the game. All participants had normal or corrected-to-normal acuity and color vision, and they gave informed written consent prior to the experiment.

A personal computer (DELL Precision 380) and color graphic system (Cambridge Research System VSG2/5) were used to control the experiment and generate stimuli that were front-projected onto a white screen using a projector (Panasonic TH-LB60NT). A custom-made response box was used for participant responses.

Stimuli were video clips of a rugby player running towards the camera, which simulated the view of the participant, and suddenly changing direction to the left or right with or without a sidestep (see Figure 2). For the stimuli, we had running actions of three rugby players, who had either competed at the national level or been selected to a regional top team, recorded with a digital video camera (SONY DCR-SR60) at 30 frames per second. The player started to run at 16 m away from the camera, which was positioned at a height of 120 m, simulating the eye level of a defensive player making a tackle, and then changed direction at either 4 or 5 m from the camera, simulating a run round a virtual defensive player to avoid a tackle. The player's running action included no sidestep, one sidestep, or two sidesteps, the latter two being performed before the player changed direction. From the recording of each player, 20 actions were chosen as the stimuli to be presented in the following experiments: for either direction change to the left or right, 4 actions included no sidestep, 4 included one sidestep, and 2 included two sidesteps. Each stimulus was digitized and edited in a form of successive frames and presented at 30 Hz on the screen. The stimulus size was adjusted to match the retinal size of the running player viewed on the field

The experiment was conducted in a dark room in which the participant was seated while viewing a screen binocularly from a distance of approximately 120 cm. Before an experimental session, the participants were given 5 min to adapt to the dark, at which time they were given the following instructions: decide, as soon and accurately as possible, whether the player shown on the screen is going to change direction to the left or right and press a corresponding button on the response box; keep a proportion of correct responses above 80% while responding fast; the running actions include, with a certain probability, sidesteps to deceive the viewer with regard to a directional change. On each trial, a white fixation point of diameter of 1.3° was presented first for 5000 msec against a black background, followed by the stimulus presentation, which was terminated when the participant made a response. RT was measured as the time from which the runner's foot last touched the ground for making a directional change (corresponding to the second and the third step for one-sidestep and two-sidestep actions, respectively) to that at which the participant pressed the button. The next trial started immediately.

Each participant completed an experimental session of 6 practice trials and 60 main trials. In the practice trials, the stimuli consisted of random presentations of directional changes to the left or the right with no sidestep, one sidestep, or two sidesteps. In the main trials, the stimuli consisted of random presentations of 60 different actions, i.e. 24 with no sidestep, 24 with one sidestep, and 12 with two sidesteps. One half of the actions included a directional change to the left and the other half, to the right.

Results

Figure 1 shows the mean correct RTs of the rugby players and the novices for the three types of stimuli separately for the direction change to the left and the right. A 2 (Group; player and novice) × 3 (Action; no sidestep, one sidestep, and two sidesteps) × 2 (Direction; left and right) ANOVA showed that all main effects were significant (Group, $F(1, 18) = 15.85$; Action, $F(2, 36) = 48.59$; Direction, $F(1, 18) = 31.07$, all $ps < 0.01$), but none of the interactions was significant. Post-hoc comparisons showed significant differences between any two of the three types of action (all $ps < 0.05$). A three-way ANOVA on the individual proportions of

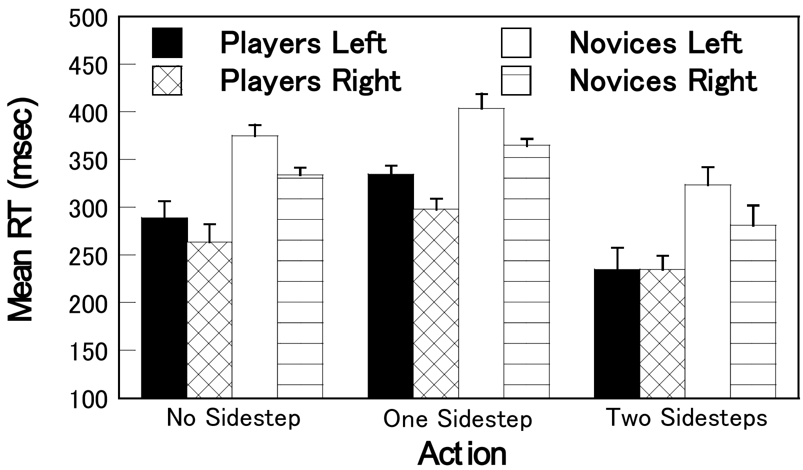

Fig. 1. Results of Experiment 1: Mean RTs of rugby players and novices for different types of motions and change directions. The vertical bars indicate standard errors of the mean.

correct responses showed that the main effect of Action was only significant ($F(2, 36) = 105.20$, $p < 0.01$). A correlation coefficient between the mean RTs shown in Figure 1 and the corresponding proportions of correct responses was $R(10) = 0.56$, $p < 0.05$, indicating a possible existence of a speed-accuracy tradeoff for the Action effect.

Discussion

This experiment showed a clear advantage of the rugby players over the novices in determining directional change of opponents running toward them. The players responded faster than the novices irrespectively of whether the directional change was made with or without a sidestep, suggesting that the players' ability to distinguish between deceptive and non-deceptive actions may not differ from that of the novices. For both the players and the novices, the RTs were fastest for the two-sidestep stimuli, second for the no-sidestep stimuli, and slowest for the one-sidestep stimuli. The two-sidestep stimuli may have been easy to determine because the participants knew that there would be no further step and could determine the running direction as soon as the players in the stimuli made the third step. The one-sidestep stimuli were difficult to determine because they contained very similar movements to the two-sidestep stimuli. The no-sidestep stimuli may have been distinguished from the other two types of stimuli because the action was real rather than feigned. However, the RT differences among the three types of actions may have been contaminated with a speed-accuracy tradeoff. This experiment also showed that the RTs were faster for the direction change to the right than to the left. The reason for the difference is not clear. In a follow-up experiment, we measured simple and choice RTs to dots appearing on the screen and found no difference between the left and the right in RTs.

Experiment 2: Temporal Occlusion Task

Method

Participants were 10 collegiate rugby players and 10 novices (mean ages, 21.4 ± 0.8 years and 22.3 ± 0.6 years, respectively), none of whom had participated in Experiment 1. The players had played rugby for a mean of 9.2 ± 2.1 years, with five of them having competed at the national level. The novices had no prior rugby training but possessed basic knowledge of the game. All participants had normal or corrected-to-normal acuity and color vision, and they gave informed written consent prior to the experiment.

The apparatus was the same as in Experiment 1 except for a personal computer (Compaq nx6320) that replaced the one used in Experiment 1. The stimuli were identical to those of Experiment 1, except that their presentation was occluded at either one of five temporal points. For the no-sidestep and one-sidestep stimuli, the occlusion points were determined relative to the last time the runner's foot touched the ground to make a directional change, and they were -300, -200, -100, 0 (the moment the foot touched the ground), and 100 msec. For the two sidestep stimuli, the 0-msec point was the moment of the second footstep (one step before making the final directional change) touching the ground, and the five occlusion points were -200, -100, 0, 100, and 200msec. Therefore, the occlusion points for both the one-sidestep and the two-sidestep stimuli were set relative to the moment of the runner making the second step, and we were able to analyze the participant's judgments for those two types of stimuli on the same temporal scale. Figure 2 shows examples of three types of stimuli along occlusion points.

The procedure was similar to that of Experiment 1 with the following changes. The participants were instructed to predict directional change (left or right) after the stimulus

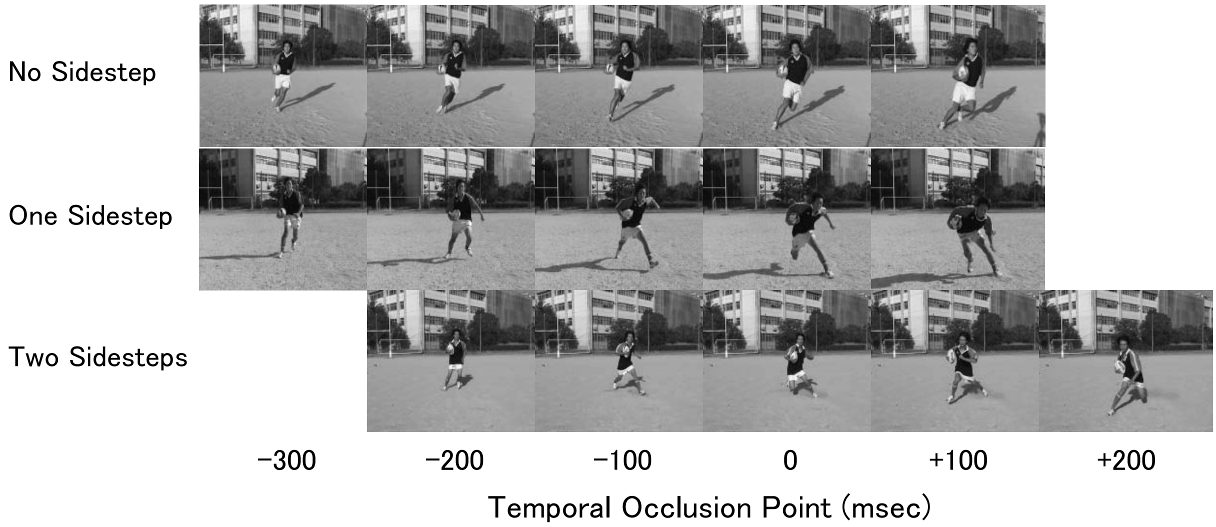

Fig. 2. Examples of stimuli along temporal occlusion points

was occluded. In each trial, the stimulus was presented up to the time of any of the five occlusion points, after which the stimulus disappeared and a response window showed up. The participant used a computer mouse to indicate ‘left’ or ‘right’ on the window corresponding to his answer. The participants were given no time constraint for responding, but they were told not to take too much time making a decision. Each participant completed an experimental session of a few practice trials and 300 main trials, in which the stimuli consisted of random presentations of combinations of 60 different actions used in Experiment 1 and five occlusion points.

Results

Figure 3 shows the mean proportions of correct responses of the rugby players and the novices as a function of occlusion points separately for the three types of stimuli. A 2 (Group; player and novice) × 3 (Action; no sidestep, one sidestep, and two sidesteps) × 5 (Occlusion; -300, -200, -100, 0, and 100 for no sidestep and one sidestep; -200, -100, 0, 100, and 200 for two sidesteps) ANOVA showed significant main effects of all three factors (Group, $F(1, 18) = 6.06$, $p < 0.05$; Action, $F(2, 36) = 290.36$, $p < 0.01$; Occlusion, $F(4, 72) = 247.67$, $p < 0.01$) and significant interactions of Group × Action, $F(2, 36) = 7.58$, Group × Occlusion, $F(4, 72) = 5.51$, Action × Occlusion, $F(8, 144) = 70.30$, and Group × Action × Occlusion, $F(8, 144) =$

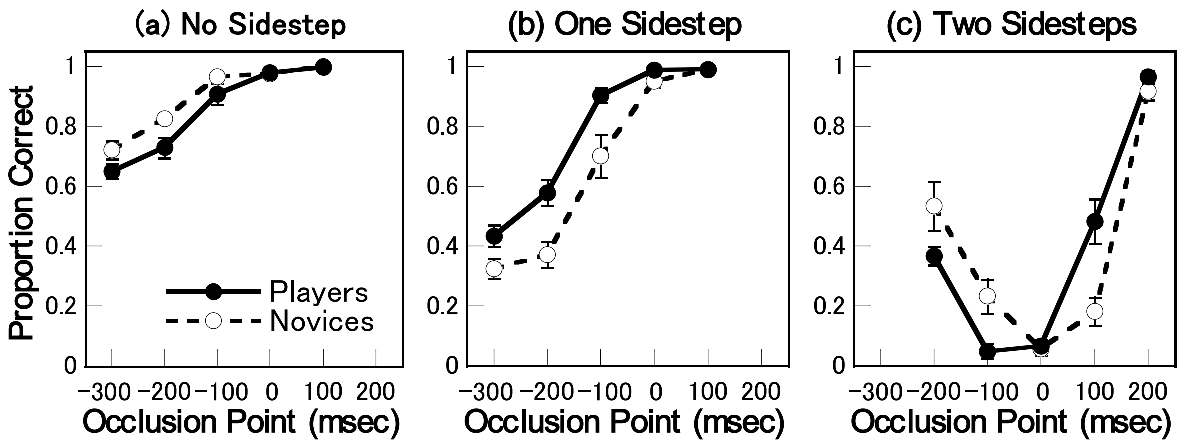

Fig. 3. Results of Experiment 2: Mean proportions of correct responses of rugby players and novices as a function of occlusion points separately for different types of actions. The vertical bars indicate standard errors of the mean.

7.62, all *ps* < 0.01. Post-hoc comparisons showed that the proportions for the one-sidestep were significantly higher for the players than for the novices ($p < 0.01$), whereas there was no significant difference between them for the other two types of stimuli.

Discussion

This experiment revealed that anticipatory responses of the experienced and novice rugby players differed among the three types of actions. For the no-sidestep and the one-sidestep actions, the performance of the two groups was increasingly accurate as the occlusion point progressed from -300 to -100 msec, after which the performance was almost perfect. It is noteworthy that the players were less accurate, although not significantly, than the novices with regard to the no-sidestep stimuli but more accurate with regard to the one-sidestep stimuli. This result can be taken as evidence for expertise knowledge of the players. The actions with and without sidesteps were difficult to distinguish when they were temporally occluded. With many years of experience, the players would have expected sidesteps even when the actions did not include one. The novices would have considered many actions to have occurred without a sidestep when those actions were difficult to determine. For the two-sidestep action, both the experienced players and the novices assessed the actions as one sidestep when the occlusion point was up to 0 msec, resulting in very low anticipation accuracy.

General Discussion

The experiments reported here demonstrated expertise perception by rugby players in situations where the opponent action can be deceptive. The RT task (Experiment 1) showed that experienced players had equal advantages over novices with deceptive and non-deceptive actions. The temporal occlusion task (Experiment 2) revealed that their anticipatory accuracy depended on whether or not the actions were deceptive (Jackson et al., 2006). The relatively poor ability of the experienced players to detect non-deceptive actions suggests that their expertise of the sport may have detrimental effects on their performance (Seya and Mori, 2007).

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