water bottle or a towel to attract attention or by simply pointing to the left or right goalpost. Perhaps also a goalkeeper walking towards the goal during a penalty shootout is more likely to induce the off-center effect by standing to the opposite side from which the goal was entered –assuming that the penalty taker is actually watching the goalkeeper. In other words, the present findings underline that not all perception of space is infallible and goalkeepers should perhaps be encouraged to try and exploit this to enhance their success. It remains for future research to identify other situations in and outside of sport in which explicit perception of space and subsequent implicit performance diverge.

Chapter 7: Courting on the beach:

How team position implicitly influences decision-making in beach volleyball serves

7.1. Abstract

A goalkeeper in soccer penalty kicking standing marginally to the right or left side of the goal’s center influences a penalty takers’ goal side selection, without the penalty taker being aware. To assess the generality of these implicit influences in other (sports) environments, we examined whether the position of players of the receiving team in beach volleyball can affect a serving player’s decision-making. To this end, two experiments were conducted. In Experiment 1, participants had to indicate to which of three areas of the court they would serve, but only when they believed that the receiving team’s positioning divided the court in three equally large areas. In Experiment 2, participants had to identify the largest of three court areas and indicate how confident they were that their decision was correct. The

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results showed that when participants were unaware of that the receivers’ positioning was asymmetrical, they nevertheless made judgments and decisions favoring a serve to the (marginally) larger court area. This effect, however, was more pronounced in Experiment 1 than in Experiment 2, suggesting that the degree to which attention is directed to the information of interest (i.e., largest court area) is an important moderator. These observations indicate that implicit effects of positioning reflect a more general phenomenon in and outside of sports that can be exploited for improving chances of success.

7.2. Introduction

Deciding where to aim a ball is a critical facet in many sports. For example, in beach volleyball, the server must decide to what area of court to aim the ball. These decisions will typically arise from tactical deliberations including the strengths and weaknesses of the two opponent players. The opponent players’ positioning, which is typically such that it divides the court in three areas of equal size, is not normally taken into account purposely, except when their positioning is obviously (and in all likelihood intentionally) asymmetrical to entice the serving player to play to a particular area. In fact, this situation shares important characteristics with the penalty kick in soccer, which has come under close scrutiny in the last 10 to 15 years (for overviews see Lopes et al., 2008 2013; Memmert et al., 2013). During the penalty kick players must decide to kick the ball either to the left or right side of the goal, albeit that they also can – and sometimes do – chose to direct the ball towards the goal’s center. Once again, the position of the goalkeeper on the goal line is typically not part of deliberate considerations to what side to kick the ball, except when the goalkeeper leaves clearly more space to one side. However, even when the goalkeeper’s position is not noticeably asymmetrical, the penalty taker’s decision may still be affected (Masters et al., 2007). That is, the goalkeeper can influence the penalty taker’s decision-making by placing
him- or herself only a few centimeters to the left or right of the goal’s center. In this situation, penalty takers proclaim that the goalkeeper stands in the exact center of the goal, but strikingly, are more likely (in approx. 60% of the attempts) to opt to direct the ball to the side with more space (Masters, et al., 2007, see also Weigelt & Memmert, 2012; Weigelt et al., 2012; Noël, van der Kamp et al., 2015). It has been argued that this so-called off-center effect is an instance of a more general and possibly pervasive phenomenon of implicit processes being actively involved in human perception and decision-making in other sports situations and daily activities.

Accordingly, we asked whether beach volleyball players’ decisions for serving the ball to a particular area of court may indeed be implicitly influenced by the receiving team’s positioning. Significantly, the beach volleyball situation is more complex than the penalty kick in soccer. Typically, in taking a neutral position (Fig. 14.), the two opponent receiving players divide the court in three areas of equal size. For this situation, conscious deliberations about the largest area are unlikely to contribute to a server’s decision where to aim the ball. Nonetheless, if the off-center effect in penalty kicking reflects a ubiquitous phenomenon, then a marginal deviation from the neutral position by one of the receiving players would go unnoticed to the serving player but may still influence his or her decision. Hence, the main purpose of the current study was to examine whether effects like the off-center effects in soccer penalty kicking also occur in beach volleyball.
The pervasiveness of a phenomenon not only relates to its ubiquitousness, but also to its stability. That is, for players or coaches who consider ways to exploit (or avoid) implicit off-center effects, it is pertinent to know how easily it can be escaped (e.g., ‘what if my opponent knows?’). Also theoretically, this is an important issue. In one of the more influential discussions of implicit involvement in perception, for instance, Dehaene et al. (2006) attribute a critical role to attention – next to stimulus strength that is. They argue that observers fail to notice a stimulus because they do not attend to it or because it is of insufficient strength. Awareness thus can be enhanced by directing attention to the stimulus of interest (e.g., in case of the off-center effect, to the area with more space) or by increasing stimulus strength (e.g., increase the difference in size of the areas). Hence, dependent on its origin, explicitly directing players to search and chose the largest area may affect the manifestation of the off-center effect. To address this issue, we examined the occurrence and extent of the off-center effect in beach volleyball in two experiments. Experiment 1 was designed such that players would not consciously search for or attend to court measures when choosing the area to serve (cf. Masters et al., 2007, Exp. 3), while in Experiment 2 players were explicitly told to search for and hence to attend to the area that was largest when deciding where to serve (cf. Masters et al., 2007, Exp. 1). In line with Dehaene et al. (2006),

Figure 14: A sample picture of the stimulus material for the neutral position.
we hypothesized that by directing attention to the stimulus of interest, the off-center effect in Experiment 2 would be reduced (or even completely vanished) compared to Experiment 1.

### 7.3. Experiment 1

In Experiment 1, beach volleyball players were shown displays of two beach volleyball players who are preparing to receive a serve. In some displays the two players were positioned such that they divided the court in three equally sized areas (i.e., neutral positioning, Figure 1); in other displays one of the players slightly or clearly deviated from this position. Reminiscent of the landmark task in line bisection (Milner et al., 1992), participants were asked whether the receiving player stood in a neutral position (i.e., whether the court areas were of equal size) or not. Following the procedures introduced in the original off-center study by Masters and co-workers (2007, Exp. 3), if the participants thought the answer was affirmative (i.e., the players indeed appeared to be positioned neutrally), they were to indicate to which area they would aim the ball. If the participants believed the answer to be negative (i.e., the players do not appear to be positioned neutrally), they did not choose an area (but proceeded with the next display). In other words, participants only made decisions where to aim the ball in situations for which they were not consciously aware that the receiving players deviated (slightly) from the neutral position and for situations in which the receiving players were actually not displaced. In the former situation, it is highly implausible that they would consciously search for or attend to the largest area in their subsequent decision where to aim. Consequently, any systematic influence of deviations from the neutral positioning should stem from implicit involvement in perception and decision-making. We hypothesized that slight deviations from the neutral positioning would indeed go unnoticed, but that participants would still prefer to direct the ball to the largest court area above chance level (i.e., > 33%).
7.3.1. Methods

Participants. The experiment was carried out in accordance with the World Medical Association Helsinki Declaration as revised in October 2008. Following the approval of the local ethics committee, 25 participants (23 male, 22 right-handed) with an average age of 25.9 years ($SD = 7.9$ years) volunteered to take part in the experiment. All participants played beach volleyball at least once per week, reported normal or corrected to normal vision, were naïve regarding the purpose of the study and also did not know about the existence of the off-center effect, neither in soccer penalty kicking nor in beach volleyball (as was verified after the experiment). Participants provided written informed consent before the start of the experiment.

Stimuli. E-Prime 2.0 software (Psychology Software Tools, Pittsburg, PA) was used to present pictures of a beach volleyball scene on a 15.6-inch Fujitsu Lifebook E754. The pictures were graphic representations reworked from a picture that shows a receiving team’s courtside with one player positioned at 4 m behind the net taken from the serving player’s position (i.e., from behind the center of the rear court boundary). The receiving player was carefully cut out and pasted in twice at different lateral locations 4 m behind the net (Fig. 14). In the neutral position, the ‘two’ players were positioned in such way that their midsagital bodylines divided the court in three target areas of equal width. In all other positions either the right or the left player was displaced to the left or the right, resulting in one of the three areas of the court being wider, one being smaller, and the third being of equal size as in the neutral position. The displacements were 0, 3, 6, 9, 12, 15, 18, and 71 pixels, which corresponds to respectively 0.00, 0.06, 0.12, 0.18, 0.24, 0.30, 0.36, and 1.42 cm on the laptop’s monitor and to 0, 2, 4, 6, 8, 10, 12, and 48 cm on a real court. The largest displacement was very obvious and served to maintain participants’ motivation. Previous
work showed that participants’ performance in evaluating stimuli suffers if only hardly noticeable and unnoticeable stimuli (here: small displacements) are presented (cf. Pratte & Rouder, 2009).

**Procedure.** Participants were instructed to decide to which of three areas of the court they would serve the ball (i.e., to the left side, the middle, or right from the participants’ perspective). However, they were only to decide if they perceived that the players stood in the neutral position. They were advised about this neutral position before the start of the experiment. It was described as the situation in which both players were positioned such that their midsagittal bodyline divides the court in three target areas of exactly the same width. A picture was used to support this explanation. To respond, the participants pressed one of four buttons on a keyboard, three of which corresponded to one of the three court areas, while the fourth served to indicate that the receiving players did not stand in the neutral position.

The experiment started with a short familiarization session consisting of five trials, after which participants were asked if they had any problems understanding the task. The subsequent experimental session consisted of 325 randomized trials, 25 of which displayed the two receiving players in neutral position. Each of three areas of the court was the largest in one third of the trials. That is, the receiving players were twice as often displaced to the inner side of court than to the outer side.

**Data analysis.** We first determined whether participants had a preferred target area by submitting the number of times an area (left, middle, right) was chosen when the receiving players were in neutral positions to a one-way ANOVA with repeated measures. Because this did not return a significant effect of area, $F(2, 48) = 0.54, p > .5$, this factor was left out in subsequent analyses. We then examined how often participants refused to serve as function of the magnitude of displacement using another one-way ANOVA with repeated measures. Subsequently, we conducted a similar ANOVA with repeated measures for the percentage of decisions that were aimed for the largest area of court. Subsequently, separate one-sample $t$-
tests were used to test whether the largest court area was chosen more often than chance level (test value 33 %, Bonferroni corrected). Either partial eta-squared (\( \eta^2_p \)) or Cohen’s \( d \) was reported to determine the proportion of total variability attributable to each factor or combination of factors.

7.3.2. Results

As can be seen in Figure 15, participants almost always (i.e., > 97% of trials) refused to ‘serve’ when the displacement of one of the receiving players was obvious, i.e., 71 pixels. For the remaining displacements, participants refuse to serve in less than 10% of trials; this included six participants who always refused at displacements of 15 and 18 pixels. This was confirmed by a main effect of displacement, \( F(6, 144) = 2057.95, p < .0001, \eta^2_p = .99 \). Bonferroni corrected pairwise comparisons indicated that the number of refusals did only differ between the 71 pixel condition and all the other conditions (\( p \)’s < .0001) whereas the remaining conditions did not significantly differ from each other (\( p \)’s > .08).

![Figure 15: Percentage of decisions not to serve as function of displacement relative to neutral position (Experiment 1). Error bars indicate standard errors.](image-url)
Figure 16 shows the percentage of decisions for the largest area\(^{10}\). Clearly, when participants decided to serve, and thus did not consciously notice that the receiving players were not positioned in a neutral position, they decided for the largest area in approximately half of their choices (i.e., 53.1%). The analysis of variance on the percentage of decisions for the largest area revealed a main effect of displacement, \(F(5, 90) = 9.2, p < .0001, \eta^2_p = .34\). Bonferroni corrected pairwise comparisons indicated that the largest area was chosen less often in the smallest 3 pixel displacement than in the other displacement conditions, which did not differ among each other.

![Figure 16: Percentages of decisions for the largest area as a function of displacement relative to neutral position (Experiment 2). Error bars indicate standard errors.](image)

Finally, Bonferroni corrected one-sample t-tests (one-sided) showed that percentages of decisions for the largest court area exceeded chance for displacement conditions of 6 pixels (and larger, \(t\)'s > 4.71, \(p\)'s < .001, \(d\) > .0001). However, for the smallest 3 pixel displacements the difference did not reach significance (\(p > .02\)).

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\(^{10}\) Figure 16 leaves out the displacement condition of 71 pixels, because participants never made a ‘serve’. They were clearly aware that the receiving players were not positioned neutrally.
7.3.3. Discussion

Masters et al. (2007) reported that in soccer penalty kicking a goalkeeper who, unknowingly to the penalty taker, stands marginally off-center entices a penalty taker to kick to the side with more space. Experiment 1 examined if similar implicit involvement in decision-making also occurs in the beach volleyball serve. Specifically, it was investigated if with marginal displacements from a neutral positioning of the two receiving players that go unnoticed, beach volleyball players still tend to choose the largest court area more frequently.

With a displacement of one of the opponent players that corresponds to almost half a meter on court, the participants were clearly aware that the receiving team was not positioned neutrally. However, smaller deviations from the neutral position generally went unnoticed, except in a few participants who also perceived displacements corresponding to 10 and 12 cm. In other words, for displacements smaller than 10 cm (i.e., < 15 pixels) participants believed the opposing team was positioned neutrally; and hence they had to decide to what area they would serve the ball. We found that even though they were not consciously aware that the defending players were not neutrally positioned and hence that the court areas were not of equal size, they systematically favored serving to the area that was slightly larger than the two others. This demonstrates that implicit perceptual processes are actively involved in decision-making. The effect was not ubiquitous, however. For the smallest displacement, which corresponds to 2 cm on a beach volleyball court, the largest area was not chosen more often than expected by chance. Likely, the displacement is so small that stimulus strength stays below the objective threshold of perception. Consequently, the implicit involvement was only reliably observed for spatial deviations that correspond to distances between 4 and 10 cm on a real court. In fact, this corresponds rather well with the 5 to 10 cm bandwidth reported for the off-center effect in penalty kicking (Masters et al., 2007). This underlines that implicit perception is sufficiently pervasive to generalize to slightly more complex environments in
which also other than spatial factors are likely to affect decision-making. For instance, the two receiving players together can more easily defend or reach the middle area than a same-sized outer area if they coordinate their actions, that is. Future works needs to verify whether these action-related factors override implicit perception in more representative situations. We think not, since the off-center effect in penalty kicking also holds in the real environment (Noël, van der Kamp et al., 2015).

The instructions in the current experiment aimed to discourage the participants to attend to the court area that was largest. This is important, because many studies that purportedly demonstrated implicit involvement in perception and decision-making have been criticized for directing participants’ attention to the critical dependent variable (e.g., Newell & Shanks, 2014). In the current experiment, however, the participants were in no way hinted that the size of the court area was of significance when deciding between the three areas. In fact, they were only required to make a decision when they explicitly perceived that the areas were of equal size. Nonetheless, Dehaene et al. (2006) argued that implicit influences in decision-making can be sustained even with attention directed at the critical stimulus. This would depend on whether the stimulus went unnoticed because it was not attended or because it was of insufficient strength. To explore this issue in further detail, Experiment 2 assessed the involvement of implicit processes when participants are intentionally looking for the largest area.

7.4. Experiment 2

In the original study, Masters et al. (2007) also demonstrated the off-center effect using a design that resembles forced-choice comparative visual search tasks (e.g., Pomplun et al., 2001). Participants were shown displays with a goalkeeper positioned (marginally) off-center and were instructed to identify which half of the goal is the bigger one, necessitating
the participants to compare both sides of the goal. In addition, they were asked to rate their confidence in the correctness of the choice. Implicit involvement was attested for by the observation that for small displacements relative to the goal’s center, participants performed above chance (i.e., > 50% correct), but reported they were guessing, i.e., had no confidence that their response was correct. We adopted the forced-choice task for the beach volleyball serve to examine whether intentionally attending to the size of the court affects implicit influences on decision-making. Similar to Experiment 1, in Experiment 2 participants were again shown displays of two beach volleyball players waiting to receive a serve. However, they were now told to judge the court area that was largest and to rate how confident they were that their judgment was accurate. Because participants’ attention was now directed at the dependent variable of interest (i.e., size of the target areas), implicit involvement in decision-making, if any, can only follow from stimulus strength being too weak to access consciousness (i.e., subliminal perception) and not from attention being diverted away from the stimulus of interest (i.e., preconscious perception). Hence, we anticipated that – relative to Experiment 1 – the implicit influences would be limited to smaller displacements.

7.4.1. Methods

Participants. The experiment was carried out in accordance with the World Medical Association Helsinki Declaration as revised in October 2008. After the local ethics committee approved the experiment, 37 participants (26 male, 11 female, 36 right-handed) with an average age of 26.4 years (SD = 5.1 years) took part in this experiment. All participants played beach volleyball regularly, i.e., at least once per week. They reported normal or corrected to normal vision, were naïve regarding the purpose of the study and had no prior knowledge about the off-center effect in penalty kicking in soccer (or beach volleyball).
Stimuli. The same pictures of two receiving beach volleyball players as in Experiment 1 were shown on a 15.6-inch Fujitsu Lifebook E754 using E-Prime 2.0 software (Psychology Software Tools, Pittsburg, PA). However, fewer displacement conditions were included: 0, 6, 12, 18, and 71 pixels, corresponding to respectively 0.00, 0.12, 0.24, 0.36, and 1.42 cm on the screen and 0, 4, 8, 12, and 48 cm on a real court.

Procedure. Participants were seated and watched the stimuli on the monitor. They were instructed to identify the largest of the three areas of the court (i.e., outer left, mid, or outer right area) or guess if they felt unable to decide. They provided their response by pressing one of three buttons that each corresponded to a court area. After each response they had to indicate how confident they were that the response was correct by marking a location on a continuous scale that ranged from “0” (complete guess) to “100” (totally sure). There were no time restrictions for responding. As per Experiment 1, the experiment started with a short familiarization session of six trials after which participants were asked if they had any problems understanding the task requirements. The subsequent experiment session consisted of 325 randomized trials, in 25 of which the two receiving players actually stood in the neutral position and the three areas were of the same size. Each of three areas of the court was the largest in one third of the remaining 300 trials, resulting in players being displaced to inner side of court twice as often than to the outer side.

Data analysis. First, we submitted the number of times an area (left, middle, right) was chosen as the largest to a one-way ANOVA with repeated measures to verify if participants perceived one area as larger than the two others. This included the 25 no displacement trials only. Because no significant effect of area was found, $F(2, 72) = 2.45$, $p = .10$, area was not taken into account in subsequent analyses. Afterwards, we calculated the percentage of trials in which the largest area was correctly identified for each of the four remaining displacement conditions (6, 12, 18, 71 pixels) and submitted these percentages to a one-way ANOVA with repeated measures. We also tested whether these percentages
exceeded chance levels using one-sample t-tests (test-value = 33.3%, Bonferroni corrected). Finally and following the procedure of Masters et al. (2007), who assumed that rating scores for the neutral position (i.e., zero displacement) reflect guessing, we used one-sample t-tests (Bonferroni corrected) to assess if the average confidence ratings for the four remaining displacement conditions exceed ratings for the neutral position (i.e., guessing level). Either partial eta-squared ($\eta^2_p$) or Cohen’s $d$ was reported to determine the proportion of total variability attributable to each factor or combination of factors.

### 7.4.2. Results

Figure 17 shows the percentage of trials in which the correct area was identified as largest together with the corresponding confidence rating as a function of displacement condition. A main effect for displacement was found, $F(3, 108) = 245.9, p < .001, \eta^2_p = .87$, indicating that accuracy of identifying the largest area increased with the size of the deviation from the neutral position. Bonferroni corrected pairwise comparisons showed that the displacement conditions differed significantly from each other ($p$’s < .001). Importantly, the percentage of trials in which the largest area was correctly identified exceeded chance level in each displacement condition including the smallest, $t’s(36) > 19.01, p$’s < .0001, $d$’s > 6.36. Finally, confidence ratings exceeded participants’ confidence rating for the zero displacement condition (i.e., guessing level) at displacements as small as 12 pixels (corresponding to 8 cm on a court), $t’s(36) > -3.19, p$’s < .005, $d$’s > 1.06. However, participants did not show increased confidence in their decisions for the 6 pixel displacement condition (i.e., 4 cm on a court), $t(36) = -1.3, p > .19$ (Fig. 16).
Figure 17: Percentage of trials in which the largest area was correctly identified and participants' mean confidence in their judgment as a function of displacement. Error bars indicate standard errors and the dashed line corresponds to guessing level.

7.4.3. Discussion

Experiment 2 scrutinized whether marginal displacements of beach volleyball players relative to a neutral positioning that are not consciously perceived can still influence a server’s decision to aim for the largest area of the court implicitly if the server intentionally searches and attends to the largest area. We found, analogous to the off-center effect in soccer penalty kicking (Masters et al., 2007, Exp. 1), that irrespective of the magnitude of the displacement of one of the receiving players, participants were able to identify the largest area above chance. Even for the smallest displacement, which corresponded to 4 cm on court, participants reliably chose the largest area. However, unlike for the larger displacements were they reported increased confidence about their judgment, participants felt they were guessing when faced with the smallest displacement condition. We take this as an indication that the participants were unaware that the receiving team stood not in a neutral position.
As expected, participants were aware of smaller differences between the court areas than in Experiment 1 (i.e., they were increasingly certain that their choice was correct for displacements that correspond to 8 cm or more on court). This suggests that directing attention towards the measures of the court areas reduces the impact of the implicit processes but does not completely annihilate it. One inference would be that part of the implicit involvement in Experiment 1 reflects preconscious perception, which only contributes if attention is diverted away from the stimulus of interest. The implicit involvement that remains when attention is directed to the stimulus of interest must be subliminal, i.e., follows from stimuli that are too weak to be noticed consciously. Accordingly, the implicit involvement was much more limited in Experiment 2. Yet, these inferences are necessarily tentative, because the procedure of the two experiments differs in more aspects than focus of attention only (e.g., other displacement conditions were used, criteria for implicitness were not identical).

7.5. General discussion

To examine the pervasiveness of the implicit involvement in decision making in dynamic situations such as sports, the current study investigated whether phenomena similar to the off-center effect in the soccer penalty kick (where marginal differences in positioning influence penalty takers’ decision without them being consciously aware of these spatial differences) can also be found in a beach volleyball scenario, the service to start a rally. The experiments show that marginal variations in the receiving team’s players positioning can indeed systematically affect decision-making of the serving player implicitly, i.e., when the spatial variations go unnoticed. Accordingly, the off-center effect is not a phenomenon that is restricted to soccer penalty kicking (or the accompanying stimulus environment) but reflects a more general implicit involvement in decision-making arising in complex environments,
possibly also outside sports. Nonetheless, it must be acknowledged that the current experiments were lab-based, implying that some of the rich dynamics of real-world beach volleyball matches are missing—as was the case in the original penalty kick off-center studies (Masters et al., 2007, Weigelt & Memmert, 2012; Weigelt et al., 2012). Yet, we have recently shown experimentally that the off-center effect holds for penalty kicking on the field involving players taking the penalty kick from penalty marks and goalkeepers actively trying to stop the ball (Noël, van der Kamp et al., 2015, submitted). This suggests that the lab-based are in fact representative for the real-world sport environments, although this still needs to be verified experimentally for the current beach volleyball scenario. Also video-analysis from competitive matches may be helpful in this respect (see also Masters et al., 2007).

Deliberate displacements from the neutral position by the receiving team’s players are not uncommon in beach volleyball.11 Typically, however, receiving players adopt relatively large displacements to elicit a serve to a particular area on court for tactical reasons. Because the strategy is easy to recognize for the serving player, it introduces strategic counter-responses as predicted by game-theory: the serving player’s decision is likely affected by the recognition that the receiving player is trying to lure him or her to play to a particular target area, and possibly the receiving player takes into account that the serving player knows, and so on. In sports, this kind of strategic decision-making is most thoroughly studied for soccer penalty kicking (see Chiappori et al., 2002; Palacios-Huerta, 2003). In brief, the findings suggest that when adopting this kind of deliberate strategies, sport players tend to maximize their chances for success while making sure that their decisions remain unpredictable. The advantage of marginal displacements from normal position is that they lure the serving player’s into a particular choice, without the players being aware that this happens. Consequently, game-theory does not apply. In fact, Experiment 2 suggests that for a narrow

11 To make sure, these arguments are based upon the knowledge and experience of the second author, who is playing beach volleyball competitively on the international level.
range of displacements, serving players can be lured into a particular decision, even if they consciously try to prevent that it befalls them (i.e., when they are on the lookout for the largest area). The serving player is unlikely to completely suppress the effect of marginal variations in positioning, because humans have been found unable to learn to counteract implicit influences on their behavior (Bressan & Pizzighello, 2008; Tsushima, Seitz, & Watanabe, 2008). In other words, explicitly attending to the marginal displacements helps reducing the effect, as was demonstrated in Experiment 2, but if the stimulus is of insufficient strength to be perceived consciously, then its influences cannot be intentionally overturned, simply because the player is not aware of it. In this regard, it is worthwhile identifying other scenarios that are subject to implicit influences. Other sports like ice-hockey and tennis that include set plays come to mind easily. Moreover, similar effects possibly occur in daily life, for instance, a car driver choosing among two parking spaces, a pedestrian walking in a crowded shopping area, or a butcher selling halve a sausage.

To sum up, the current study demonstrates that the off-center effect is not unique to soccer penalty kicking. Marginal spatial differences that go unnoticed also occur in beach volleyball, indicating that implicit involvement in decision-making may be a more general phenomenon in sports. The current study shows that these implicit influences can be exploited to influence another person’s or sport player’s decision-making. The effect persists (although significantly reduced) even if the other person deliberately pays attention to it.

Chapter 8: Epilogue

The current thesis addressed both theoretical and practical issues related to various strategic, perceptual and action aspects of soccer players’ penalty kick performance. To this end, it expanded upon and combined two largely separate strands of research. First, Chapters 2 and 3 investigated how penalty takers can best approach the penalty kick strategically, by