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**A reply to**

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# An explicit investigation of implicit decision-making processes

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## ABSTRACT

Using the concept of ecological rationality, different conclusions from those of Poplu, Baratgin, Mavromatis, and Ripoll in "What kind of processes underlie decision making in soccer simulation? An implicit-memory investigation" (2003, *International Journal of Sport and Exercise Psychology, 1*, 390-405) can be drawn. The choice of environmental context and structure imposes constraints on possible interpretations of the obtained results. The implications of Poplu et al.'s data, new evidence, and the relationship between implicit and explicit decision-making processes are discussed with the aim of enhancing performance in real game situations.

KEY WORDS: implicit and explicit processes, decision making, sports, ecological rationality

**An explicit investigation on implicit decision-making processes**

Poplu, Baratgin, Mavromatis, and Ripoll (2003) asked in an recent article (*International Journal of Sport and Exercise Psychology, 1*, 390-405) the important question, what kind of processes underlie decision making in soccer simulation? The authors can be congratulated on their experimental investigation and their conclusion that "the results showed that the nature of the processing depended on the characteristics of the decision-making task being considered" (2003, p. 390). I would like to comment on one theoretical and one practical issue, not to question the value of the empirical findings themselves but rather to suggest how these results can be integrated in a theoretical framework that extends Poplu et al.'s approach and offers practical advice for real training settings.

Theory

It is commonly understood that decision-making processes depend on the structure of the task at hand. The Nobel laureate Herbert Simon (1990) said it best when he described behavior as being shaped by a pair scissors whose two blades, structure of the environment and an agent's computational capabilities, necessarily must be considered together. The concept of ecological rationality describes human behavior from an adaptive perspective such that the success of any decision-making process depends on the problem structure, or the structure of the environment. I will comment on the environmental analysis in Poplu et al.'s experiment as well as on their decision-process analysis.

*What is the ecological structure of the situations used in the experiments?*

Poplu et al.'s (2003, p. 395) experiments 1 and 2 presented participants (novice and expert soccer players) with still pictures taken from video sequences of 10 soccer players (5 offense, 5 defense) in situations providing at least two or three good choices of action (equal probabilities) before a goal could be scored (i.e., a dribble, a pass, and a shot). In a priming phase 40 situations (pictures) were presented. This was followed by a test phase consisting of 60 situations, 20 identical to the priming phase, 20 symmetrically the same but rotated, and 20 entirely new. Whereas the situations (perceptual information) were identical for the two experiments the task instructions were not. In experiment 1 participants had to choose between three options (shoot, pass, or dribble). In experiment 2 participants had to generate a game sequence of three actions, such as pass, dribble, pass (to keep possession) or dribble, pass, shoot (to score a goal). The task (35 m from the goal to reduce constraints on the decision-making choices) in experiment 1 was a typical forced-choice option-selection task (one choice from three options given); the task in experiment 2 was an option-generation task such that a sequence of three options had to be generated in the desired order to form a sequence of choices.

*What are the processes that underlie decision making in soccer simulation?*

The cognitive processes assumed to be used in the two experiments were classified as low-level (activation of perceptual knowledge) and high-level (activation of conceptual knowledge, acquired through the internalization of abstract, domain-specific rules) processes. Perceptual and conceptual knowledge are linked in a "richly connected network" (Poplu et al., 2003, p. 397).

The description of this dual-process theory (low-level and high-level processes) in the article is not detailed enough for us to be able to evaluate how the different types of knowledge (conceptual and perceptual) are used, nor how these processes interact. Different possible interaction models of high-level and low-level processes need to be tested to determine if both processes are active in a task and to ascertain if both processes influence the choices.

*What processes are related to what ecological structure?*

Argument 1

The authors conclude that high-level processes are involved if a task necessitates a multiple-step calculation. “This means that experts activate conceptual knowledge in order to resolve problem situations of this type” (Poplu et al., 2003, p. 400). The number of “calculation steps” seems to be one potential ecological variable but it is not a very strong candidate to revealing the structure of decision making processes for two reasons.

First, empirical evidence indicates that even if multiple steps need to be calculated, perceptual and not conceptual knowledge may influence decisions. For example, in sports experiments with option-generation tasks (e.g. choosing among options such as shoot, pass, or dribble), people who had little conceptual knowledge could intuitively make good decisions with short reaction times (Johnson & Raab, 2003). In option-preference tasks, as well (e.g. what team will win? Name one intuitively or think about the reasons), again in multiple-step calculations not much conceptual knowledge was found yet people still produced good inferences or valid preferences that could hardly be attributed to their minimal existing conceptual knowledge (Halberstadt &

Levine, 1999). Participants' good decisions were more likely to be attributed to their perceptual knowledge (e.g. direct perceived distances between players to decide to whom to allocate the ball) or to one-reason decision making (e.g. I have heard of only one of these teams, therefore I bet the team I recognize will win), than to abstract conceptual knowledge.

Second, two lines of research, on implicit cognition and on intuitive decision making, substantiate the experimental data just given. It has been argued that in implicit cognition, in which, for example, performance in sequential reaction-time tasks is sensitive to conditional probabilities up to at least the second order (e.g., Hoffmann & Koch, 1998), even the representation of implicit learned information is based on the memory of perceptual or motor sequences and is thus non-conceptual or abstract. In intuitive decision making (e.g., Klein, 2003), for instance, in recognition of chess patterns, perceptual cues (e.g. the chess figures) enable us to recognize patterns that activate action scripts (e.g. activate an attack combination) without necessarily being based on high-level processes.

Argument 2

The authors argue that low-level processes should underlie decision making if an option-selection task is applied, in which participants have to choose from among several choices the appropriate one. "Based on the results of experiment 2, the low-level processing hypothesis can be generalized, but only to tasks that require a decision involving a one-step calculation" (Poplu et al., 2003, p. 401). This argument seems arbitrary for the following reason.

Consider the expert players in both experiments of Poplu et al. (2003) who had each played for more than 10 years. In a number of situations it seems plausible that they would have received conceptual knowledge from their coaches in the form of if-then rules (condition-action rules), as described by the authors, as well as various experiences in these situations on the field. Its seems obvious that the kind of training players receive can influence how much they rely on perceptual or conceptual knowledge even in an option-selection task. For instance, in the same issue of *IJESP* as the article discussed here, I presented four experiments in which teaching participants if-then rules in basketball, handball, or volleyball resulted in verbalizable knowledge of these rules that could be used to choose from among four or five options given. Defining the verbalizable knowledge as either perceptually based (e.g. "I used the distance to my opposed defender to decide to shoot or to pass") or conceptually based (e.g., If the situation develops that the player to my left is free and no nearer option to the goal is available then I pass to the player to my left") reveals that players use conceptual knowledge more if they have been trained to use it, whereas players having only experience with the situation (no formal training) rely on perceptual knowledge (Raab, 2003). Thus decision-making processes that underlie option-selection tasks—even if only one-step calculations are required—are based on low-level *and* high-level components "in this richly connected network," as labeled by Poplu et al.

*How to explain the results differently?*

The response times for primed situations were faster compared to symmetrical primed situations in experiment 1 (use of perceptual knowledge) but not in experiment 2 (use of conceptual knowledge) for experts. There were no differences in these conditions in soccer novices. What are the alternatives to a single-knowledge explanation for the difference between experts' reaction times in experiment 1 and experiment 2?

*Alternative 1: Both high-level and low-level processes were activated but the different task instructions in experiment 1 and in experiment 2 led to different levels of influence of these processes on the choices and the response times.*

How can this be tested? First, testing participants to reveal their conceptual and perceptual knowledge could allow us to see how much of each type of information is represented in experts (and novices). For instance, perceptual knowledge could be explicitly asked for in recall tests, as has been done by others (Ward & Williams, 2003). Conceptual and perceptual knowledge could also be evaluated by visual and verbal recall *and* recognition tests (e.g. Raab, 2003). If more perceptual knowledge was used in experiment 1 compared to experiment 2 then we would also expect better performance in explicit perceptual tests compared to conceptual tests, because perceptual information has already been activated.

Second, if mainly perceptual knowledge guides choice selection for one-step-calculations as argued by Poplu et al. we can expect the same choice response in experiment 1 and the first choice response in experiment 2 for the primed conditions. However, this would not hold for the symmetrical primed conditions. Data provided by the authors concerning this logic would help us evaluate Alternative 1.

*Alternative 2: Mainly perceptual knowledge was used in both experiments but the task instruction cause different strategies where to start in the choice list and how to generate sequential choices in experiment 2 compared to experiment 1.*

If task instruction changed the leverage point (Klein, Wolf, Militello, & Zsambok, 1999) at which the perceptual knowledge search should begin to make a choice, then we would expect differences in the first answers in the primed conditions in experiment 1 and experiment 2 at each expertise level. Furthermore, the difference between novices and experts in choice consistency in experiment 2 need not be based on different amounts of conceptual knowledge used to make these choices. For instance, Johnson and Raab (2003) showed in handball that option generation between novices and experts differs in the magnitude of inconsistency because of a different option-generation strategy. For instance, novices strategies are spatially or perceptually orientated and experts strategies are more functionally orientated and thus options such as pass to the left or pass to the right are functionally equivalent and cause no differences between primed and rotated primed items. Experts used less of their conceptual knowledge and relied on their intuitive choices from one-calculation steps as argued by Johnson and Raab (2003).

*Alternative 3: The difference of reaction times within experts is marginal and has no practical meaning.*

The difference between the reaction times for experts in experiment 1 for the faster primed condition and the slower symmetrical primed condition is 132 ms, whereas the same difference in experiment 2 is 94 ms, with standard deviations of about 500 ms. These differences are of a magnitude of 38 ms. However the first difference was significant and the second difference was not. Given that no effect sizes are presented, the power of this first investigation on implicit memory in sports cannot be judged. Further data needs to be provided by the authors and more research is needed to test Alternative 3 against the others.

Regardless of which alternative provides more evidence, it seems clear that reaction time differences need more than one dimension of the task structure than presented from an ecological rationality view. I think the chosen dichotomist perspective of perceptual and conceptual processes is a valid one and needs to be extended by clear predictions of how these processes interact. For instance, Chaiken and Trope (1999) defined four different interaction modes (selective, competitive, consolidative, and corrective) from which two were experimentally tested in handball decision tasks that differed in their degree of complexity (Raab, 2002a).

Furthermore I do not think that the ecological structure of the tasks and the instructions used are defined clearly enough. What are the ecological variables that influence the decision processes underlying the observed behavior? For instance, time pressure may explain the use of perceptual or conceptual knowledge better than the distinction of perceptual and conceptual knowledge systems. In one lab and one field basketball experiment (Raab, 2002b) that introduced different degrees of time pressure a model confirmed by simulations could predict choices that are based mainly on perceptual information (25% of time that is required to make appropriate decisions) whereas a preference reversal toward an alternative option occurred if more time was given, because information from previous choice success could be integrated into these decisions. Thus what is missing is a clear description of the environmental structure of these situations, something that was asked for long ago in psychology but is still missing in decision tasks in sports.

Practical Consequences

"On the basis of our findings it is tempting to think that whenever a player is in an organizing position (e.g., a ball distributor) and there is no heavy time pressure, he/she engages in a multiple-step form of reasoning to plan the upcoming actions. However, a player about to terminate (e.g., a scorer) would most likely bring perceptual knowledge into play. One cannot risk such a generalization without a supporting investigation in a real situation" (Poplu et al., 2003, p. 402).

I agree with the warning about overgeneralization, but I want to note that the "supporting investigation" called for by Poplu et al. already exists. For instance Ward and Williams (2003) give recommendations about perceptual training based on results of perceptual and cognitive developments in soccer. There are also models, such as the Tactical Awareness Approach (Griffin, Mitchell, & Oslin, 1997) and the Teaching Games for Understanding (McMorris, 1998), that promote the training of conceptual knowledge while taking implicit memory (or learning) into consideration, but they do so with a more explicit teaching strategy. In addition there are concepts such as SMART (Situation Model of Anticipated Response-consequences in Tactical training, Raab, 2001) that define different interaction terms for perceptual and conceptual knowledge depending on the situation at hand. Practical advice for real situations in sports should include situations such that time-pressure, complexity of perceptual and conceptual demands of the given (or to be generated) choice set are variable.

To conclude, asking what kinds of processes underlie decision making in sports is a valid question. Poplu et al. (2003) defined and tested candidate processes for soccer simulations. An analysis of the interaction of these processes as well as a description of ecological variables that influence the use of these processes in decision making seems still to be lacking and these are essential to understanding choices in real sports situations.

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