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Interactions between Conception and Perception in Expert Basketball Players

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In this paper we discuss the role of skill and knowledge acquisition on perception alteration. Two experiments are described in which perceptual-related variables are influenced by expertise. Experiment 1 shows how eye movements are constrained by skill level in a similarity judgment task. Experiment 2 sheds light on knowledge organization and its effects on perception. Results reveal that Categorical Perception (Goldstone, 1994; Harnad, 1987) occurs in expert players: Acquired distinctiveness was found, that is experts were better than novices for distinguishing between briefly-presented schematic basket-ball configurations only when stimuli belonged to different categories. Taken as a whole, results tend to demonstrate that knowledge guides perception towards a particular functioning mode based on structure analysis and stimulus categorization.

Previous research has shown that experts in various domains have a deeper understanding of the situations in their domains. In the same time several studies, namely in sport context have produced descriptive data on the evolving character of perceptual variables during learning (perceptual chunking acquisition, enhanced perceptual discrimination, alteration of interest's areas). Unfortunately less is known on knowledge organization in memory and on links between expert knowledge and perception. The aim of our research is to give an account for these two points.

For Goldstone (in press), "[i]ssues related to concepts and categorization are nearly ubiquitous in psychology because of people's natural tendency to perceive a thing *AS* something". This claim underlines that initial information is usually associated to further information provided by people's conceptual background. In some domains, however, access to functional information is restricted to a limited number of people. This is the case of basketball play configurations that can be "interpreted" by skilled players while novices will be limited in this proceeding. In order to investigate the role of this interpretation function on perceptual processes we used a similarity judgment paradigm. Such a paradigm implies processing of both relational information and elements attributes: "[…] in literal similarity, both relational predicates and object attributes are shared" (Gentner & Markman, 1997, p. 48).

In a first experiment we have tested the hypothesis that expert better performance in a similarity judgment task (Ripoll, Baratgin, Laurent, Courrieu, & Ripoll, 2001) is the result of a structural processing. At the contrary, novices were assumed to be unable to link elements of configurations because of their lack of conceptual background. This state would make them produce different perceptual mechanisms than experts' one. Namely, we thought that they would encode only positions, not relations and that

differences between expert and novice encoding would be observable by eye movements' analysis.

In a second experiment we attempted to give evidence for a categorical organization of knowledge in expert players. Furthermore we hypothesized a conceptual (categorical) effect on perception in these participants.

Experiment 1

Differences in eye movements parameters between experts and novices were predicted during similarity judgments. Hypotheses concerning these parameters were directed toward structured-targets processing understanding: Number of fixations were expected to be more stable in experts than in novices across similarity conditions. That is experts were hypothesized to usually extract structure before doing a comparison as novices' visual behaviors were expected to depend tightly on the number of elements displaced in target configuration relative to source configuration.

Method

Seven expert basketball players and 7 novices took part in this experiment. Response accuracy and eye movements were recorded. We measured number of fixations and mean fixations duration for each source and each target configurations. Stimuli were schematic basketball configurations made up of crosses representing attackers and lines representing defenders. Twenty-four of them were structured configurations (i.e., coherently organized relative to the logic of basketball activity as defined by coaches) and twenty-four were unstructured (i.e., not coherently organized). Similarity between source and target was manipulated and could vary according to four levels: 0, 1, 2, or 3 differences. In structured configurations each physical difference generated also a semantic distortion. There was as many (i.e., 12) different as identical pairs of configurations in each structure condition. Participants had to judge for each trial, whether source and target were same or different. Source was presented during 4 seconds and was followed by a mask for two seconds. Then, target appeared and was not removed until a response key is pressed.

Results and Discussion

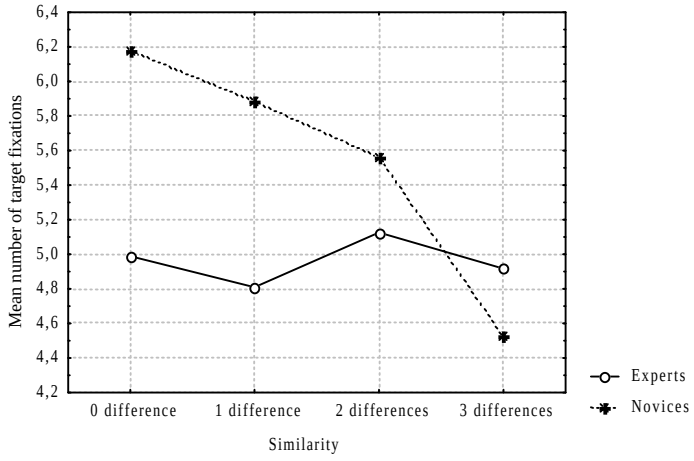

Figure 1. Target processing: Mean number of fixations as a function of source-target similarity (Experiment 1).

Experts are better than novices at discriminating patterns of play [F (1,12) = 15.78, p < .05]. A source-target similarity main effect [F(3,36) = 24.35, p < .05] is observed, and post-hoc analyses reveal that accuracy is better for 0 and 3 differences than for 1 or 2 differences. A source-target similarity main effect on number of fixations is found, F(3,36) = 5.07, p < .05 and post-hoc tests (p < .05) allow us to show that in the "3 differences" condition, participants produce less fixations than in the three other conditions. However, this point is to be related to the expertise x source-target similarity interaction [F(3,36) = 4.91, p < .05]. Only novices have their number of fixations changed across similarity conditions: fixations are less numerous in " 3 differences" than in the three other similarity conditions. The tendency in novice number of fixations is to decrease as the source-target dissimilarity increases. Experts are not found to have their number of fixations changed with source-target similarity manipulation. They produce less fixations (p < .05) than novices in "0" and "1" difference conditions (see Figure 1).

No difference in eye movements parameters is found in experts across conditions. Empirical evidence is given across studies that expertise in a domain enhances discrimination abilities of configurations that are semantically distorted. We assumed that this performance is supported by knowledge acquisition and stimuli "featuring". That is, making a comparison for an expert doesn't imply only extracting and mapping position and identity of elements: this is also processing structural features. This point seems to be verified when analyzing number of fixations during target processing. In novices, the more similar the two stimuli, the more important the number of fixations during recognition. We think that when the number of differences increases the probability for finding quickly (i.e., early in the processing) local mismatches between configurations (cross or line that is not at the same place as in source) increases. For this purpose, the number of fixations required to find a mismatch decreases. In experts, number of fixations of the target is stable across similarity conditions. It seems that their processing requires a number of fixations that is independent of number of elements displaced. We think that this stabilization of behavior across similarity condition means that experts don't make stimuli comparisons based on local mapping, but rather run a structural mapping involving relations between elements.

Experiment 2

Categorical organization of knowledge was expected to determine perceptual information encoding and to influence discrimination. We thought that differences (in a similarity judgment task) between configurations would be variously detected by experts, as a function of category identity manipulation. Differences between configurations belonging to different categories were hypothesized to be very well detected by experts, while novices should not be affected by category identity manipulation. No expert-novice difference (or novice better performance) was predicted when difference doesn’t alter category identity .

Method

Nine expert basketball players and 11 novices were involved in this experiment. Stimuli were schematic basketball configurations and were distributed by pairs. From one

source configuration, two target configurations were built. The first one was manipulated so as to be in another category than source configuration, and the second so as to stay in the same category. Physical distortion between source and target configurations was controlled and was of an equal intensity in both cases. So for we used a cluster encoding method validated by Courrieu (2001). Stimuli were presented sequentially (each during 1200ms), with no inter-stimuli delay. Number of correct responses was recorded.

Results and Discussion

A source-target similarity main effect [$F(2,36) = 44.17$, $p < .05$] emerges, and post-hoc analyses reveal that performance is the best when the two configurations are identical, and that participants are better when difference is between-category than intra-category. This last result is due, as shown by expertise x source-target similarity interaction [$F(2,36) = 5.24$, $p < .05$], to experts' higher performance when category boundary is crossed. Post-hoc analyses give evidence that their performance in "distorted" conditions depends on category identity manipulation. When configuration is distorted but category is not changed, experts have not a significantly different performance than novices, and score of correct responses is low (41.12%). However, when distortion makes the category identity change, then expert performance is high (70.48 % of correct responses) and different ($p < .05$) from novices' one. Novices' performance is not found to be different across the two conditions where stimuli are different.

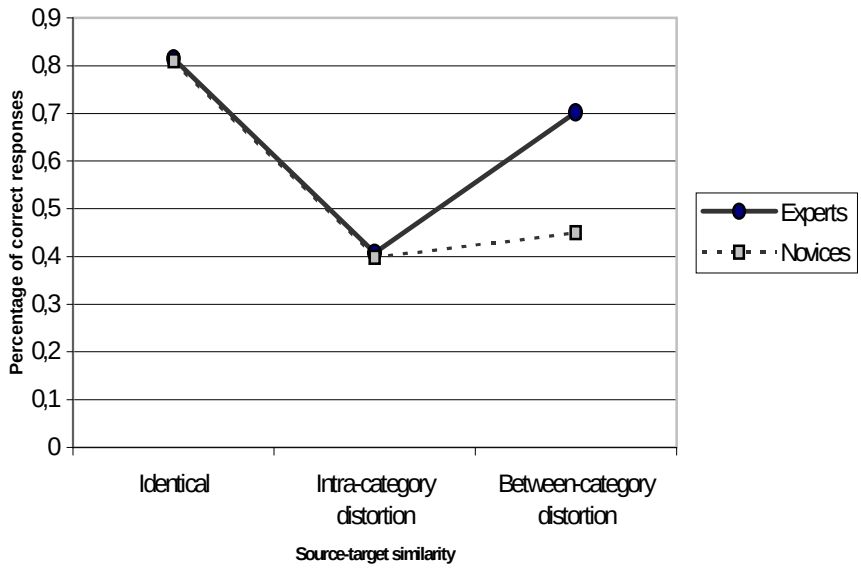

Figure 2. Accuracy as a function of source-target similarity.

Discrimination performance in experts depends on category identity manipulation. That is, perceptual distinctiveness acquisition in experts is linked to categorical organization of knowledge. These effects are interpreted as evidence that categorical perception occurs in basketball context.

Conclusions

Both experiments show that perceptual processes are influenced by expertise in basketball. Eye movements are guided during similarity judgment by previous experience in the domain. We think that number of fixations stability during target processing in experts reveals this adaptation as being directed towards stimuli structure analysis. Categorical effects on perceptual discrimination have been demonstrated. This supports the assumption that experts' knowledge is categorically organized and that this organization is relevant to understand expert perceptual processes. Results obtained here support the thesis of conceptual processes involvement in perception organization.

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