

Time matters! Implications from mentally imaged motor actions.

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ABSTRACT

Pylyshyn provides sound arguments against the dominant picture theory of mental imagery. However, we claim that mental imagery, like visual perception, is intrinsically dynamic and that the very nature of mental imagery will not be uncovered by studying static pictures. Understanding mental imagery of motor actions reveals that any theory of mental imagery should start off with the temporal nature of real-life experiences.

Pylyshyn's criticism of the picture theory of mental imagery is inspiring and a welcome counterpart to those theorists who thought that they had resolved the debate (see Kosslyn, 1994). Although we appreciate his contribution, we believe that a fundamental aspect of all mental imagery is missing and that the debate, regardless of how it is defined by the participants, focuses on a rather artificial topic, which might be one of the factors that makes the debate seem so persistent and insoluble. In this commentary, we will focus on what the study of human motor and sports behavior can add to the ongoing imagery dispute.

The imagery debate, as a discussion on the nature of mental imagery, has neglected the temporal aspect and limited itself to visual imagery of pictures, disregarding all other kinds of imagery. We think the

consideration of mentally imaged motor actions would contribute much in the search for a theory of mental imagery, a theory that should proceed from the inherent dynamic nature of all mental images and should not include solely geometric properties. For instance, Pylyshyn incorrectly argued, that “intrinsic properties of images are geometrical rather than dynamic” (p. 5). To sustain this, he insisted that baseball fielders predict the point where the ball will land (Gigerenzer & Selten, 2001). However, this is not what they do. Rather, they use dynamic properties (e.g. tracking optical acceleration of an approaching fly ball to guide locomotion in catching; Oudejans, Michaels, Bakker, & Davids, 1999).

Basic to the debate is a discussion on how visual perception operates. Mental images occur in the absence of the imagined scene; therefore, imagery is based on the recall of any kind of experience (see Boschker, 2001). The imagery debate is to a certain extent reducible to a discussion on what the nature, or in Pylyshyn's term, the cognitive architecture, of visual perception is. Kosslyn's notion of visual mental imagery, the picture theory, is certainly most closely related to the widely rendered idea that perception is about appointing meaning to detected stimuli and the processing of percepts. Pylyshyn, on the other hand, suggests that there is something special about mental imagery that is not found in the picture-like view of imagery, and although he does not elaborate in depth on this special characteristic of imagery, he also seemed to support the idea that visual perception starts with the detection of geometric properties.

It seems that both parties in the debate have adopted an inappropriate view of perception. Perception is not the passive detection of meaningless geometric properties, but the active pick-up of the significant features of an ever-changing environment. The imagery debate focuses on visual perception of motionless pictures and ignores that behavior is all about change and adaptation to changes in one's environment. The human nervous system, and the nervous systems of every organism, is constructed to detect changes. When sensory organs (on the retina, in our muscles, or in our skin) are exposed to a constant stimulation, the produced signal quickly decreases. For example, it is very difficult to tell if the temperature is 8 or 14 degrees Celsius, but a change of half a degree is easily detectable. Visual perception is equipped to pick-up the most relevant or meaningful features of the environment, and these features appear to be predominantly changes within the optic array. When mental imagery is based on previous experiences, it will thus reflect the dynamic nature of perception (Freyd, 1987). We need a fundamentally different notion of perception and imagery that is based on the dynamics of the perceptual system.

Moreover, pictures are in fact rather artificial features. Although one could argue that distilled pictures are basic to perception and that motion is established by a specific sequence of adjacent pictures related to each other in time, this is more or less turning the world upside down. The human natural environment or 'ecological niche' does not consist of computed displays or printed pictures. The human perceptual system evolved long before such things existed. Pictures are manmade frozen moments in time that have little to do with normal behavior of organisms. It seems odd to imply that such an artificial activity could ever reveal the very nature of any behavior.

If dynamics are so essential in behavior, why not start with movement imagery, instead of the rather artificial activity of imagining pictures? But what do studies of mentally imagined motor actions tell us about the nature of mental imagery? For instance, it has been found that mental images are most vivid when all sensory modalities (visual, kinesthetic, haptic, auditory, olfactory, and taste senses) are involved and not only the visual one (Murphy & Jowdy, 1992). Second, a mental image of solely (visual) stimuli properties is not likely to affect behavior; for this it is necessary to mentally imagine (motor) responses as well, that is, to simulate behavior (Boschker, 2001; Lang, 1979). Finally, Boschker, Bakker, and Rietberg (2000) and Boschker, Bakker, and Michaels (in press) indicated that the effects of movement imagery are most pronounced when the imagined motor action is used to interfere with subsequent behavior, instead of enhancing it. These findings suggest that dynamic images of action scenes are not only possible to create, but highly effective in modifying behavior. This implies that mental imagery is all about responding: “our general view ... is that the mind (i.e., the ensemble of cognitive events) is a system for organizing and directing responses” (Lang, 1987, p. 408).

In conclusion, 'in search of a theory' for mental imagery, the fundamental dynamics of every living creature should not be neglected. A theory of mental imagery of motor actions has to integrate temporal and kinesthetic properties of the image. These properties are neither pictorial nor spatial and are highly

relevant to explain why temporal components of real and imaged actions are highly correlated (Frak, Paulignan, & Jeannerod, 2001) and why images are constrained by the biomechanical properties of the body (Munzert & Raab, in preparation).

REFERENCES

Boschker, M. S. J. (2001). Action-based imagery: On the nature of mentally imagined motor actions (doctoral thesis). Vrije Universiteit Amsterdam, The Netherlands: Ipskamp PrintPartners.

Boschker, M.S.J., Bakker, F.C., & Michaels, C.F. (in press). Effect of mental imagery on realizing affordances. *Quarterly Journal of Experimental Psychology: A - Human experimental psychology*.

Boschker, M.S.J., Bakker, F.C., & Rietberg, M.B. (2000). Retroactive interference effects of mentally imagined movement speed. *Journal of Sports Sciences*, 18, 593-603.

Frak, V., Paulignan, Y., & Jeannerod, M. (2001). Orientation of the opposition axis in mentally simulated grasping. *Experimental Brain Research*, 136, 120-127.

Freyd, J. J. (1987). Dynamic mental representations. *Psychological Review*, 94(4), 427-438.

Gigerenzer, G., & Selten, R. (2001). Rethinking Rationality. In G. Gigerenzer & R. Selten (Eds.), *Bounded Rationality* (pp. 1-12). Cambridge, MA: MIT Press.

Kosslyn, S.M. (1994). *Image and brain: The resolution of the imagery debate*. Cambridge, MA: MIT Press.

Lang, P.J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology*, 16, 495-512.

Lang, P.J. (1987). Imagery as action: A reply to Watts and Blackstock. *Cognition and Emotion*, 1, 407-426.

Murphy, S. M., & Jowdy, D. P. (1992). Imagery and mental practice. In T.S. Horn (Ed.), *Advances in sport psychology* (pp. 221-250). Champaign, IL: Human Kinetics.

Munzert, J., & Raab, M. (in preparation). Information processing in sports (*Encyclopedia for psychology*).

Oudejans, R. R. D., Michaels, C. F., Bakker, F. C., & Davids, K. (1999). Shedding some light on catching in the dark: Perceptual mechanisms for catching fly balls. *Journal of Experimental Psychology: Human Perception and Performance*, 25(2), 531-542.

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