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FROM PIAGET'S ASSIMILATING MIND TO NAVON'S CLOCKLAND: TOWARDS A CATEGORICAL ACCOUNT OF MIRROR VISION.

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Abstract

In this commentary I discuss Navon's interpretation (2001) of mirror reversal in "perception". In his framework, Navon emphasizes the notion of prototypicality for explaining left-right reversal awareness. I argue that in any domain of life, it is a common phenomenon to process information with respect to background knowledge. From Piaget's assimilation view to Navon's left-right reversal of mirror perception, the evidence of prototypicality effects on reversal awareness is reviewed. It is concluded that Navon's view is plausible but subject to some object-related constraints.

Keywords

Prototypicality, categorical perception, assimilation, mirror vision, left-right reversal, frontal encounter, symmetry, critical perceptual features.

1. Navon (2001) proposes a prototypical account of image reversal awareness. He assumes that our left-right reversal perception when the mirror is parallel to the front of the object, is due to our familiarity with frontal encounters. For instance, individuals are used to facing other people and to seeing them inverted cross-laterally relative to their own body. However, though mirror perception suggests a frontal encounter, it is different from it because in the former case, intrinsic homologous sides are not laterally opposite to each other. Hence, background knowledge would act as a frame of reference for comparison, and so, for the perception of reversal.

2. First, to delineate the scope of my commentary, I will begin by defining the aspects that will be discussed and what level of analysis will be used. Since it is agreed here that early percept shaping is underlaid by the anterior-posterior reversal entailed by the mirror, our discussion is directed toward a later processing, namely, left-right reversal awareness. In this view, the reflected image is simply changed by the fact that a back-front reversal occurred. So, the transformation is not accompanied by any other reversal. What was at the top is still at the top, what was on the left of the observer is still on his or her left. However, there is a discrepancy between these physical data and the observer's psychological experience.

3. It is because there is no cross-lateral inversion that observers perceive a reversal. If there were a cross-lateral reversal with a back-front reversal at the same time, there wouldn't be any reversal perception, simply because the image would be similar to that of a frontal encounter. Navon's view comes into the picture at this point.

4. Navon's idea about prototypicality effects on mirror vision implies that individuals "read" the world through their knowledge. This "reading phenomenon" is a basic foundation of cognitive psychology, one of whose primary interests is to discover how knowledge guides information processing.

5. In this field, Piaget's concept of assimilation (e.g. Piaget, 1936) describes information extraction and processing. According to Piaget, information passes

through existing structures or schemes, and trough this process adaptive behavior is associated to inputs. Navon's view of left-right reversal perception involves stored perceptual information. It is the case that Navon sees reversal as being perceptually embodied (see paragraph 16). In his framework, the nature of the information processing involved in the perception of mirror reversal on the plane parallel to its surface is, in the end, nothing more than an assimilating activity of vision. Indeed, visual information is processed quite directly, passing through a kind of frame of reference (i.e. prototypical information).

6. In his studies on development, Piaget explains that perceptual schemes allow the perceiver to assimilate only a part of the information available in the environment. In other words, what individuals take into account depends on the nature of the schemes that provide usable information. In Navon's view of mirror vision, what the perceptual system deals with depends on the perceptual background stored in each of us. Hence, a percept is directly associated to what the individual knows about his or her environment (i.e. frontal encounters). If he or she accesses a reversal, it's because of the embodied "assimilative" structures that tend to psychologically organize the sensory input. This is illustrated by the fact that in Navon, reversal perception "is due to the interface of an optical law and a conceptual habit" (see paragraph 16). The perception of reversal is due to "ingrained schemata" (see paragraph 36) that weigh on perception. The parallel between the two approaches lies in their common assumption that available perceptual information depends on the internal knowledge structures that individuals possess.

7. The discrimination between mirror reflection and frontal encounters may therefore be the source of left-right reversal perception. Support for background influences on perceptual discrimination abilities has been obtained trough psychophysical experiments in the field of categorical perception (Harnad, 1987). The data suggest that the conceptual organization of knowledge modifies perceptual similarity spaces by emphasizing between-category distortion and/or reducing within-category distortion. The principle of these experiments is to investigate the link between physical variations and their associated phenomenal variations. Navon stated the problems as in psychophysics: He reports a "contradiction between two facts - one phenomenal and the other physical" (see paragraph 4) that concerns the differential processing of the left-right and top-bottom axes. So far, conceptual-perceptual interaction has been demonstrated by using similarity-based paradigms. In the case of mirror reversal, can we say that similarity relations are important? Yes, given that we look at people from the front, the most similar case is a frontal encounter. With regards to categorical perception, it may be that when facing a mirror we activate the category related to the current situation. In that case, a prototype representing that category could be a frontal encounter and may be used for making the comparison.

8. However, it seems that we are facing a (second?) puzzle. How can it be that when activating the same category, discrimination is possible between the two exemplars?

9. One hypothesis is that we have to refer to frontal encounters because no closer prototype exists for associating the mirror reflection to stored knowledge. The

discrimination between the two patterns would then be possible by the perceptual differentiation of the stimuli in which some object features (i.e. the asymmetrical ones) would play a critical role in the direct perception of a reversal. This is why I propose that Navon's view on the direct perception of differences can be accommodated with further cognitive processing (e.g. mental rotation) in some cases where critical perceptual features are not immediately available.

10. So, imagine you are facing a mirror and are thereby activating, as suggested by Navon, the prototypical cases belonging, for instance, to a "facing sight" category. You will then have access to the category-related attributes of the frontal encounter prototypes, such as the cross-lateral inversion along the horizontal axis. However, your detection of the distortion between the prototypes and the reflections of objects will be more or less direct, depending on the characteristics of the objects considered in the scene.

11. In the same manner, reversal is not always obvious in humans facing mirrors. I assume that in the case of highly symmetrical objects, categorical knowledge generates similarity relations between the prototype and the mirrored image, without providing individuals with critical perceptual features for distinguishing between the two percepts belonging to the same category. This is particularly clear when you compare the reflection of symmetrical and asymmetrical letters (for example, compare a mirrored M with a mirrored B). Therefore, the discernment of the "distortion" in mirror perception may be helped by a later processing, such as the rotation of the body along the vertical axis, to compare one's own "facing" position

with the mirrored position. Other local criteria can be taken into account, such as the intrinsic side, where the wristwatch is usually worn. Furthermore, movement is a support for perceiving the reversal. Indeed, when you move your left arm, the dynamics created by this action give you additional clues for perceiving quite directly, that the moving arm in the mirror is clearly the intrinsic opposite (i.e. right) arm. Note that both taking in local cues or creating movements are ways to create asymmetry in the object to be mirrored. In any case, we can posit that left-right reversal is made possible by a combination of clues. These clues allow for the more or less direct perception of the reversal as a function of the availability of early discriminative features (i.e. intrinsic asymmetry).

12. Actually, the prototype-induced awareness of left-right image reversal proposed by Navon wouldn't be the strongest case for prototypical effects entailed by environmental experience. For example, classical experiments report upside-down perception provoked by prismatic lenses. When participants wear these lenses for about a month while living normally, their perception gets attuned to the stimulation, so that they end up perceiving as normal, the top being up and the bottom being down. When removing the lenses people again see upside-down for a certain period, at the end of which vision gets attuned once again to the new situation. These data support the hypothesis that some constraints weigh on visual perception to organize the stimulation so that it becomes "normal". In fact, compared to this phenomenon, the normalization of perception proposed by Navon, is a "lighter" and "later" constraint provided by stored standard situations (i.e. prototypes).

13. Moreover, top-down effects on perception are biologically plausible. Empirical evidence of such effects has been found in early vision. Recent neurophysiological studies highlight the need to consider feedback information going from higher-level to lower-level cortical structures. In the domain of vision, for example, area V1 integrates information coming from upper areas V3 or V5. This suggests that very early processing is affected by higher-level structures. In this field, Hupe, James, Girard, Lomber, Payne, and Bullier (2001) presented flashed visual stimuli to monkeys and recorded neuron responses to the stimulation. Their results showed that even the earliest responding neurons were affected by feedback from area MT (i.e. by a higher-level area). Mechanisms of this type, if generalized both in the ventral and dorsal systems, may account for high-level effects on perception.

14. In conclusion, interactions between stored and incoming information have now received some empirical validation and have some biological plausibility. Acquired knowledge is known to be compelling for visual perception, namely, for image reversal. In this context, it seems to me, that a prototypical account of left-right reversal awareness, when the mirror is parallel to the front of the object, has both physical and psychological foundations. However, I posit that reversal perception is more or less direct, depending on what critical perceptual clues are available, such as the asymmetrical features of the objects.

15. Indeed, I think that reference to a frontal encounter in this situation is just a case of the normalization of perceptual information, illustrating a more general assimilating tendency of the human mind.

NOTES

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