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Teleological perception without a biological perceiver?

Théophile Ohlmann
Laboratoire de Psychologie Expérimentale
UMR CNRS 5105
BP 47
38040 Grenoble CEDEX 9
FRANCE
theophile.ohlmann@upmf-grenoble.fr

Bernard Amblard
Centre National de la Recherche Scientifique
Laboratoire de Développement et Pathologie du Mouvement
BP 71
13402 Marseille CEDEX 20
FRANCE
amblard@lnf.cnrs-mrs.fr

Brice Isableu
Université Paris Sud-XI
Division STAPS
Centre de Recherche en Sciences du Sport
UPRES 1609
91 405 Orsay CEDEX, Batiment 335
FRANCE
Brice.Isableu@staps.u-psud.fr

Abstract: Strong between- and within-animal differences during spatial activities lead us to claim that a given animal is directly sensitive to a given substructure of the global array. This vicarious subset is not cut out by the senses but by redundancies emerging from physical properties. We argue that the subset is not a single ambient array, or a combination of single ambient arrays, but a complex holistic part of the global array.

The assumption that perception is not divided into separate senses does not imply that animals are directly sensitive to the structure of the global array (GA). This is rather often not the case, because of the animal/environment mutuality, the GA should be broken down or filtered into subsets according to each animal's idiosyncrasy. We assume that these within- and between-animal differences are not linked to senses but to physical properties of the ambient array. In any case, animals can only pick out a subset of the physical reality. Actually, as they are driven by reinforcement (Skinner, 1984), their major purpose is to achieve actions, and not merely to extract an accurate perception of the reality, an assumption which would be teleological. Therefore some subsets of the reality are sufficient and the multidimensional GA is not necessarily systematically sampled out.

Strong between-animal differences both in spatial activities and in spatial disorders provide evidences that senses work in order to give an sufficient idiosyncratic perception based on a functional subset of the GA (Ohlmann & Marendaz, 1991). Biological systems (Schull, 1990) do not have predetermined or a priori solution of the world which they are coping with. In mild conditions such as walk regularly or to stabilizing one's posture on a flat resistant surface, redundancies can give rise to precise co-variations between the different sub-arrays. In such case a quasi single array is indifferently *sufficient* to control the task. Is there anybody or anything that oblige the animal to work at a higher level ? This question has nothing to do with the issue of separate senses. Thus, perception of a subset of GA such gravito-inertial (GI) forces involves a large set of senses : Golgi receptors, vestibular system, motor proprioception, kidneys (Mittelstaedt, 1997), tactile pressures, body fluids….

Moreover, in many circumstances there is no need to perceive reality accurately; indeed, action should be easier if one discards some disturbing aspects of the reality. In many cases, animals actively or passively make use of filter-like systems which are brought into play by the characteristics of the situations or/and of the individual.

According to Kimura‘s neutralism model (Kimura & Ohtha, 1968), the level of constraints directly entails consequences about the between-animal differences. When an animal is confronted with low constraints, redundancies lead to a vicarious diversity (Reuchlin, 1978). It means that if some information (data, senses, tools, affordances, part of the GA…) is substitutable to some other information, then a given animal will rely on one kind of information whenever it finds itself in a similar situation.

A clear example of the non necessity to pick out the GA each time is given by the visual Romberg's Ratio (Amblard et al., 1985). Body movements are successively recorded in total darkness and in illuminated environment. Postural stability is dramatically increased when optics are available. However, there is a strong between-animals variability which is caused by the extraction of a non GA, some subjects (Lacour et al. 1997) keeping the same level of stabilization in darkness and in illuminated environment. Actually, Isableu et al. (1997, 1998) showed that field independent (Asch & Witkin, 1948) did not need visual information to stabilize their body even in a complex stance. In order to achieve almost the same level of postural control, field dependent subjects needs full optical information. Some subjects appear to be sensitive to both *geometrical and kinematic* optical information (Guerraz et al., 1998) while others rely on *dynamics* (either static or kinetic). These subsets constitute vicarious referents not based on senses but on physical properties of information. Thus, Pick (1972) assumes that non visual spatial information can be "coded" in a visual mode because of physical properties of optics independent of the visual modality per se. This was enlightened by de Volder et al., (1999) who demonstrated that early blind subjects, fitted out with ultrasonic devices, exhibited a distinct activity (PET) in the primary visual area. Furthermore, some other subjects showed an high sensitivity to forces whatever their nature (inertial, frictional, gravitational..) which led them to primarily refer to moments of inertia (Pagano et al., 1996), static moments, gravito-inertial forces. For example, they easily find subjective or postural vertical, either directly by vestibular system, tactile compression, interoception or by the dynamics of balance (Stoffregen & Riccio, 1988, Riccio, Martin & Stoffregen, 1992) Their superiority in any domains involving moto-somato-sensorial control could be easily explained by a postural scheme extracted from the inertial tensor associated with each rotating corporal segment. Finally, this vicariousness even appears at cell level. Waespe & Henn (1977, 1979), showed that in vestibular nucleus of awake monkey, one given cell works either with a visual stimulus or an inertial stimulus, or with a combined visuo-vestibular stimulus.

Why are between-subject differences about motion sickness so dramatic ? The postural hypothesis of motion sickness, developed by Stoffregen and Riccio (1991) is unable to account for these differences. In some circumstances accurate reality or global reality is not helpful for the animal, which is well illustrated by the tilting train. In a curve when the cabin is quasi aligned with GI force, the subject has the feeling to be upright while the landscape appears tilted (Ohlmann et al., in press). This outside visual flow is a useless referent and severe motion sickness can appear even in a seated reading subject. Reduction of the available information by pulling the blinds suppresses motion sickness by annihilating the conflicting information provided by the two visual referents (cabin and landscape). Actually, a strong correlation appears between motion sickness triggered by tilting train and motion sickness induced experimentally during a previous exposition to an oblique rotating optokinetic cone (a control cone rotating in pure yaw exhibits no correlation with the train motion sickness). This implies that some subjects who usually rely on visual geometrics (cabin) and kinematics (outside flow) feel an intra sensorial conflict between referents.

In conclusion, it seems that Stoffregen and Bardy's heuristic approach of perception may appear, in some circumstances as unrealistic because of its excessive generality. We agree with the idea that each situation is specified by the global array, however, we claim that different animals perceive different subsets of specification. In any case these differences are piloted by the characteristics of the senses. If we take again the Gestalt example of the perception of triangle used by the authors, animals perceives a part of the whole i.e. an incomplete triangle which is not an isolated element, but a sufficient substructure. This working might explain why some theoretical positions like amodality, functional modality, intermodality and multimodality are sometimes simultaneously possible.

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