Direct theory of perception : an évaluation by representatives of indirect théories of perception

J. P. Wagemans

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Summary : Direct theory of perception

Gibson's theory has generated a lot of discussion with indirect theories of perception. But how do representatives of these theories evaluate Gibson's ecological approach? In this article an attempt is made to provide an answer to this question. The very diverse reactions are split up into two large groups: Criticisms and reconciliation attempts. The criticisms stress the need for computational and representational processes. Four kinds of reconciliation attempts are distinguished: (1) Changing stimulus patterns and decoding principles, (2) direct information pickup as part of a perceptual cycle, (3) not all perception is direct, and (4) direct perception as preattentive processing.

Key-words : direct perception, representation, computation.

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University of Leuven
Laboratory of Experimental Psychology¹

**DIRECT THEORY OF PERCEPTION
AN EVALUATION BY REPRESENTATIVES
OF INDIRECT THEORIES OF PERCEPTION²**

by Johan P. WAGEMANS³

RÉSUMÉ : *Théorie directe de la perception : une évaluation par des psychologues représentatifs de théories indirectes.*

La théorie de Gibson a engendré beaucoup de discussion autour des théories indirectes de la perception ; mais comment les représentants de ces théories évaluent-ils la théorie de Gibson ? Nous essayons ici de répondre à cette question. Des réactions très diverses apparaissent au sein de deux groupes d'attitudes : soit critiques, soit favorables. Les attitudes critiques spécifient qu'il est nécessaire d'introduire des processus de computation et de représentation. Les tentatives d'accords sont réparties selon quatre principes : (1) changement des principes de décodage du stimulus, (2) l'extraction de l'information comme une partie du cycle perceptif, (3) toutes les perceptions ne sont pas directes, (4) la perception directe comme processus préattentifs.

Mots clés : perception directe, représentation, calcul.

1. INTRODUCTION

The controversy between direct and indirect theories of perception is a hot topic in the recent literature about perception. Congresses where these matters are discussed, are numerous and important articles appear in many journals. This

1. Tiensestraat 102, B. 3000 Leuven, Belgium.

2. I am grateful to Dr. G. d'Ydewalle for a review of a previous version of this article.

3. Present address (until May 1986) : Psychologisch Laboratorium Vakgroep Psychologische Functieleer, Montessorilaan 3, Postbus 9104, 6500 HE Nijmegen.

article concerns part of this debate, namely the evaluation of direct or ecological theory by representatives of indirect theories of perception. The reactions are very divergent and it is impossible to represent them exhaustively. An attempt is nevertheless made to group these reactions and to summarize them.

According to indirect theories, perception is the elaboration of an inadequate stimulus input. According to the direct theory of perception, on the other hand, stimulus information sufficiently specifies the environment, so that the perceiver only has to detect this information, not to elaborate it. Most authors view this opposition as the core of the contrast between direct and indirect theories of perception (*e.g.* Ben-Zeev, 1984; Bruce and Green, 1985; Mace, 1974; McArthur, 1982; Pick, Pick, Jones and Reed, 1982; Turvey and Shaw, 1979). The answer to the question of *what* is perceived, seems to have important influence on the answer to the question of *how* one perceives. These two questions are generally considered as central problems for every theory of perception (*e.g.* Mace, 1974; Marr, 1977).

In spite of the mutual entanglement of both questions, a tendency exists among indirect theorists to appreciate the ecological study of the available information, without agreeing with the theory of direct information pickup. The criticisms are therefore generally aimed at the manner in which ecological or direct theory views the perception process. Taking this into account, one tries to reconcile the direct study of the available information with the indirect theories of information processing.

2. CRITICISMS

As stated above, representatives of indirect theories of perception criticize direct theory for their account of information detection. In summary, this theory is the following: invariants and affordances corresponding to properties of the environment have to be abstracted from the light by the perceiving organism; then, the organism resonates with or is tuned in to the environment, so that the organism's behavior is adapted to it. According to indirect theories, abstraction and resonance are not sufficient. These mechanisms of perception have to be completed with computation and representation (Fodor, 1980; Natsoulas, 1983, 1984; Ullman, 1980).

2.1 *Computation instead of abstraction*

Direct theory is generally reproached for not giving an explanation of the mechanisms of information detection (Braddick, 1980; Haber, 1978; Hayes-Roth, 1977, 1980; Hudson, 1983; Pomerantz and Kubovy, 1981). It is stated that the ecological approach does not account for the complexity of information detection (Marr, 1982; Prazdny, 1980; Shepard, 1981, 1984; Wilding, 1983).

Gibson (1973) himself admits that the process of extraction has not been fully understood yet and his followers (*e.g.* Reed and Jones, 1981) also agree that further research about it is needed. It is however possible to resist the criticism that direct theory has nothing to say about information pickup. Although direct theory is still in its infancy and is not yet "perfect", ecological theorists assert that extraction of invariants in the stimulus information offers a sufficient explanation of the mechanisms of perception.

Indirect theorists on the contrary, claim that direct theory is not only suffering from growing pains, it is fundamentally deficient. According to Ullman (1980) and Haber (1983) perception is indirect, because information pickup can be analysed in different subprocesses. A demonstrable correlation between light properties and environmental characteristics is no proof of the absence of cognitive processes, according to others (Ben-Zeev, 1981, 1984; Fodor and Pylyshyn, 1981; Wilcox and Edwards, 1982, 1983). Still, computational theory is grateful to Gibson for his studies which convincingly demonstrate the richness of stimulus information. It is not astonishing therefore that Marr (1982, p. 29) writes: "... the nearest anyone came to the level of computational theory was Gibson...". But theories as Marr's (1977, 1982) and Ullman's (1979, 1984) go further than Gibson: The detection of invariants is considered a complex problem of information processing dividable into different stages. What is computationally processed then, are those stimulus properties which appear to be ecologically relevant in normal circumstances. That is the reason why so many researchers (Braddick, 1980; Gregory, 1981; Hinton, 1980; Pribram, 1977; Runeson and Lind, 1981; Wilcox and Edwards, 1983; Zucker, 1980) consider Gibson as a forerunner of the computational approach (Pylyshyn, 1984).

2.2 Representation instead of resonance

A second fundamental criticism against the direct approach concerns the result of the perceptual process. This is conceived as "resonance" or "tuning" and has been made clear with a radio metaphor (Gibson, 1966; Michaels and Carello, 1981; Shaw and McIntyre, 1974). Important environmental properties "broadcast" information by means of electromagnetic radiation (light) "modulated" by reflection. The peripheral sensory organs "receive the information like an "antenna" and the organism is further "tuned in" to it. What is important in this metaphor, is that information is never stored in the form of a symbolic representation. By means of the same metaphor, Weimer (1977, 1980) has demonstrated where the explanation fails: A radio receives the information present in the light waves, but this does mean that a radio perceives. For a radio to be able to perceive, it would be necessary to construct a perceptual experience. The information may be directly present in the order of the stimulation, the experience is not. This implies construction and inference processes on the basis of representations. Others also stress the importance of the experiential element in perception (Attneave, 1982; Ben-Zeev, 1981, 1983, 1984; Dretske, 1978; Natsoulas, 1974, 1978, 1983, 1984; Shepard, 1984). Likewise, discussions between Gibson (1969) and Yolton (1968) and between Gibson (1972, 1973) and Gyr (1972 *a* and *b*) can be reduced to this topic. Even the criticisms of Hamlyn (1977) and Heil (1979, 1981) handle this problem. Fodor and Pylyshyn (1981) explain the problem by means of an example. If you watch the Pole Star, you see a big round ball of burning gasses. This perception depends only upon the stimulus information specifying this star. But to see the Pole Star *as* Pole Star, implies an influence from knowledge. The difference between *to see* and *to see as* may seem trivial, but it is not. For it concerns the fundamental link between perception and behavior. Somebody who is lost in the middle of a foggy night, has to know that he is seeing the Pole Star to be able to orient himself by means of this star. The seeing of just one or another burning ball is insufficient as a point of orientation. One has to see or recognize the star as the Pole Star, to base one's behavior on that perception. The cognitive consequences of perception are thus not only dependent on *whether* the world is seen or not,

but also on *how* the world is seen or represented. To explain this difference, indirect theories are based on the notion of mental representation. Direct theory explains the perceiving of X as the detecting of the corresponding invariants X' in the available light. But what happens if some people see X as an animal, others as a dog, a German shepherd or the neighbour's dog Sam? Are these perceptual experiences caused by different properties in the light? To answer this question positively, would lead to an endless proliferation of stimulus properties (de Wit and de Swart, 1983; Hudson, 1983). To avoid this, indirect theories of perception have made an appeal to mental representations, which can be more or less detailed, depending on the available knowledge.

In summary, indirect theories consider computational and representational processes necessary to give adequate explanations of information pickup and perceptual experience. Taking into account these criticisms of the ecological notions of abstraction and resonance, a number of reconciliation attempts are proposed.

3. RECONCILIATION ATTEMPTS

When good as well as bad elements are found in the same theory, an attempt to improve the theory can be made by maintaining the better parts and complementing it with good aspects of another theory. This may be done in the case of Gibson's direct theory of perception. One may try to integrate parts of ecological and constructivistic theories in a meaningful manner. Various attempts have been made to do just that. These different attempts have been divided into four groups.

3.1 *Changing stimulus patterns and decoding principles*

A first way to supplement Gibson's ecological approach, comes from meeting the above mentioned criticism about information abstraction. Many theorists agree in stressing the richness of stimulus information, in changing stimulus patterns in particular, but consider the extraction of invariants from the flow of information as a complex process of information processing. Johansson (*e.g.* 1970) has always explicitly stressed Gibson's merits and the accordances between their experimental work. But he has refuted the thesis of direct perception theory whereby

a moving organism receives *specific* information about the environment through the changing stimulus patterns and therefore needs no further information processing. According to him and many others, it is necessary to appeal to decoding principles which automatically split up the complex changing patterns in their constituent parts (Epstein, 1977, 1980; Johansson, von Hofsten and Jansson, 1980; Ullman, 1979; Wilcox and Edwards, 1982). Johansson (1970) himself has stressed the fact that this analysis of movement takes place automatically and inevitably and thus never leads to a dangerous subjectivity of the organism. He has explicitly viewed his line of work as a compromise between two extremes: "... It is our opinion that our research program will help us to avoid a not uncommon appeal to subjectivity in the basic functions of the visual apparatus, but at the same time to avoid following the pendulum swing to the other extreme: An unstructured belief in stimulus information..." (Johansson, 1970, p. 74). In reply to this, Gibson (1970) has called the contrast between the contributions of perceiver and external stimulation a false one. From the ecological point of view, this reconciliation attempt is thus disposed of as a "muddle of thought".

3.2 *Direct information pickup as part of a perceptual cycle*

Taking into account the criticisms of a direct theory of resonance, another reconciliation attempt between ecological and constructivistic theories is possible. Somewhere in a theory of perception, a place must be given to the perceptual experience. Neisser (1976, 1977, 1978) does this in his theory of the perceptual cycle. The information about the environmental object is present in the light and is picked up directly. This changes the existing cognitive schemata of the perceiving organism. These mental representations in turn indicate the right direction for further environmental exploration and further scanning of the available information. The need for an explanation of the non-randomness of this exploration process is also stressed by others (Ben-Zeev, 1981; Hayes-Roth, 1980; Norman, 1979; Weckowitz, 1972). Neisser (1976, p. xii) himself says that the notion of schemata is at the core of his "...attempt to reconcile the concepts of information processing and information pickup, both of which capture too much of truth to be ignored...". Other reconciliation attempts can be submitted under the same heading (Ben-Zeev,

1983, 1984; Hirst, 1978; Pribram, 1977; Shepard, 1984; Weimer, 1974 a). All consider perception as a constructive process, based on abstract information which is picked up directly.

3.3 *Not all perception is direct*

Some critics admit that direct perception is possible under optimal circumstances, because elaboration processes are superfluous when sufficient stimulus information is available (Hochberg, 1981; Pomerantz and Kubovy, 1981; Shepard, 1984). This would not differ much from Gibson's position, except for the fact that these people immediately add that such situations rarely occur. Mostly, information in the ambient optic array is not sufficient to specify the objects and events in the environment. Here *direct* and *indirect* are considered as two ends of the same continuum: The difference is a matter of degree, dependent on the interaction of task difficulty and stimulus richness (Baron, 1980; Clark, 1978; McArthur, 1982; Norman, 1983; Ullman, 1980). Gibson (*e.g.* 1970) also inclines to this position, but his ecological followers radically refuse to take such a stance.

3.4 *Direct perception as preattentive processing*

This reconciliation attempt is not fully independent of the previous one. Here, construction is considered the normal case, because a conscious, explicit perception implies the construction of an internal representation. Gibson's direct perception on the other hand, is viewed as an exceptional form of unconscious, tacit information pickup (Aurell, 1984; Bridgeman, 1980; Halwes, 1974; Koenderink, 1980; Turvey, 1974; Weimer, 1974 b). This form of information detection is compared with what Neisser (1967) has called *preattentive processing* (Halwes, 1974; Koenderink, 1980; Weimer, 1974 b, 1980). Some people for example can pickup a given name from the newspaper with remarkably high speed and accuracy. For doing this, one has to learn to experience the visual information without constructing the experience. One has to learn to scan the visual field, just to look without knowing what one is seeing. Only when detecting the needed word or object, one has to construct a representation so that one is aware of it. By means of preattentive processing, tacit knowledge is reached, knowledge that is possessed without knowing that it is possessed (Polanyi, 1964, 1966). This possibility has been taken into account by Gibson (1976, 1978) as is

apparent from the following citation: "...We will perceive directly and immediately their affordances for us. The meanings will be tacit of course, not explicit..." (Gibson, 1976, p. 415). But Gibsonians after him, though enthusiastic about it at first (e.g. Turvey, 1974), later rejected this reconciliation attempt.

4. CONCLUSION

It is astonishing how much trouble is taken by representatives of indirect theories of perception to integrate the merits of direct theory in the cognitive framework. Equally striking is the vehemence with which representatives of the direct or ecological approach want to get rid of these reconciliation attempts. Gibson and his ecological followers stress the revolutionary character of their approach and point out the intrinsic incompatibility between direct and indirect theories of perception (Cutting, 1982). This is an essential feature of what Kuhn (1970) has called *revolutionary* periods in science. Therefore, Gibson's direct theory of perception can be considered as a "paradigmatic revolution" against the cognitive approach as "normal science". This thesis has been defended elsewhere (Wagemans, manuscript in preparation), and has some important consequences. It implies that the struggle between the two approaches can never be decided by one single, so called "critical" experiment. Still, relevant experimental research is wanted and has been done recently, but it can only be considered as a contribution to a possible solution in the long run (Aurell, 1984; Norman, 1983; Wagemans and d'Ydewalle, manuscript in preparation). Meanwhile, it can be interesting to continue the debate on a theoretical or metatheoretical level. Here, part of this debate has been summarized and synthesized to make up a temporary balance.

SUMMARY : Direct theory of perception

Gibson's theory has generated a lot of discussion with indirect theories of perception. But how do representatives of these theories evaluate Gibson's ecological approach? In this article an attempt is made to provide an answer to this question. The very diverse reactions are split up into two large groups: Criticisms and reconciliation attempts. The criticisms stress the need for computational and representational processes. Four kinds of

reconciliation attempts are distinguished: (1) Changing stimulus patterns and decoding principles, (2) direct information pickup as part of a perceptual cycle, (3) not all perception is direct, and (4) direct perception as preattentive processing.

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