Perception and Cognition

Analyzing Object Recognition

von
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The analysis of object recognition

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Introduction

The Perception and recognition of objects have long been an issue in the cognitive neurosciences as well as in the philosophy of mind. How can it be that we associate feelings, ideas, and thoughts to clusters in space that we call »objects«? How do we select the relevant aspects of our surroundings, so that our perceptual input serves our immediate needs? How do we proceed from a perspectival view of an object to the understanding of three-dimensional objects in space?

This work provides an analysis of visual object-recognition and object perception in biological systems in order to discuss two major issues:

The first issue, originating from the field of epistemology, deals with the question in how far the content of perception is influenced or even construed by conceptual knowledge. The theoretical origins of this point will be discussed in chapter 1 and will be reviewed with the help of empirical findings in the course of the book.

The second issue concerns the role of perception within the cognitive system at large and its interactions with other components of this system, such as higher cognition (as exemplified by reasoning and knowledge-holding systems), action, and feelings. The philosophical conceptions of the relation between perception and cognition will also be discussed in chapter 1 – the term »cognition« will be used throughout in the sense of higher cognition.

These two principal issues – the adequate characterization of the content of perception and the relation between perception and cognition – are intertwined. By discussing the case of object recognition as ranging at the interface of perceptual and cognitive processes, a theory of the content of perception can be provided which circumvents a variety of problems traditional accounts have to deal with.

This work represents an interdisciplinary approach, bringing together arguments from philosophy and evidence from psychology and the cognitive neurosciences.

Throughout the chapters, I will introduce empirical findings from the fields of neurobiology, cognitive science, neuropsychology and -physiology in order to ground the argumentation – and its main tool: the three-stage model of perception – in a scientific, naturalistic framework. In such an »interdisciplinary« approach, in which philosophical requirements meet science, it can be shown that perception and cognition lie on a continuum and, moreover, that they mediate each other. This provides the foundation for a detailed definition of elements of a cognitive system which work together in the process of object recognition.

As already announced, the argumentation will rely on insights derived from a new conceptualization of the relation between perception and cognition. In order to analyze this relation, I am going to introduce a model of perception which distinguishes between three different aspects of visual perception: the informa-

tion processing system, the content of perception and higher-order perceptual cognition.

The traditional picture of perception as a passive information system and that of cognition as primary user of perception – both of which are introduced in chapter 1 – can thereby be replaced by an interactionist account, in which the direction of flow of information is no longer unidirectional, i.e. stimulus-driven but in which higher-cognitive processes also feed back into the process of perception and thereby play a vital part in constituting the content of perception. With the help of the three-stage model it can then be shown that cognitive faculties control perceptual processes to a certain extent, and that knowledge can indeed influence the way things are perceived. The content of perceptual experience can thus be construed as a function of subpersonal information processing as well as of higher-order cognitive capacities; concepts can therefore play a role in and for perceptual experiences without being constitutive for them.

Before I introduce the three-stage model in chapter 3 in detail, I will introduce empirical methods for the study of perception and cognition in chapter 2. There, I will also introduce current models of object recognition, the so-called two-stage models, and exemplify why they do not fully satisfy philosophical demands.

In chapter 4, I will discuss the role concepts and cognition play in perception by introducing a variety of examples such as visual expertise, visual illusions, ambiguous figures and perceptual bias.

In the final chapter, chapter 5, I will firstly discuss again the way object representations – in this case the representation of faces – are organized in the brain; secondly, I will integrate a new element into the architecture of perception and cognition thus far developed, namely, the element of feelings (or affects). It will be shown that these play a vital mediating role for the way things are judged and »seen« and it will thereby become evident that perceptual experiences derive their contents not only from the perceptual analysis of the world, but also from prior experiences, knowledge, expectations, and background states of the perceiver such as moods and feelings.

1
Perception and Cognition

In this chapter I will discuss philosophical conceptions of the relation between perception and cognition. In philosophy, perception is analyzed in terms of perceptual experience. A central issue arising from this perspective is the appropriate characterization of the content of perceptual experience. I claim that the philosophical debate about this issue is fruitless, therefore I propose a different starting point for the investigation of the content of perception. The relations and interdependencies of perception and cognition will be discussed by considering the case of object recognition.

The issue central to this work is the human capacity to recognize visually perceived objects.

In recognition, the perceiver does not only »see« an object, he also forms a judgment about it. A tomato can be perceived as a red, round item without the perceiver knowing that it is a tomato; at the same time it can be recognized as a tomato; it can be judged as useful for lunch or as overripe; it can serve as an inspiration to make tomato-soup. In the moment of perceiving, the subject employs object-related knowledge which allows him to deal with the object at hand. The perceiver's source of information is his sensory input. The sensory information, the »raw material« of visual experiences, offers a great variety of options concerning which objects, properties or relations can be »picked out« for conceptualization. Reconsider the tomato-example. Even if a subject does not possess the concept of a tomato, he can still experience a red, round object. In addition to this, there is a variety of qualities inherent in an object which can trigger an even greater number of cognitive reactions. It is a criterion of cognition to ascribe different concepts to one and the same object, whereas in perception (or experience) one and the same object can be presented in many different ways (positions, sizes, different lighting conditions) and still be subsumed under one and the same concept.

These observations justify the claim that the ability to recognize objects requires a connection between the sensory and the cognitive system. The nature of this connection has been matter of debate.

In the following sections, I will first introduce philosophical accounts dealing with the relation between the sensory system and the cognitive system – in short, with the relation between perception and cognition. For this purpose I am going to review ideas by Gareth Evans (section 1.1, p. 17), Fred Dretske (section 1.2, p. 19), John McDowell (section 1.3, p. 22), and José Bermúdez (section 1.3.3, p. 33).

In the picture Evans (and also Dretske) sketch of perception, perceptual experience is the output of subpersonal level information processing, and the contents

of perceptual experience are subject to cognitive evaluation. Thus, this model posits three successive stages of perception: (i) the encoding of visual information which leads to (ii) conscious visual experiences the contents of which are being (iii) evaluated by the cognitive faculties.

According to Evans, the major difference between perceptual experience and perceptual judgments is that the content of perceptual experience is non-conceptual whereas the content of cognition is conceptual. This characterization of the content of perceptual experience, however, is a matter of debate. John McDowell claims, that the contents of perceptual experience must be conceptual. This is necessary because only if the contents of perception are intrinsically similar to the content of thought, only then can the contents of perceptual experience represent the world to be a certain way.

I will show (section 1.3.1, p. 27) that there is no solution in the debate between conceptualists and non-conceptualists of perceptual content and I will try to provide a diagnosis as to why there seems to be so little progress in the matter. I suspect that there are two different notions or understandings of how perceptual experience should be characterized, which amounts in essence to this: philosophers mesh two aspects of perceptual experience – the semantic, content bearing aspect, and the phenomenal, qualitative aspect. Subjectively these aspects cannot be differentiated, therefore, I will argue that perceptual experience as such does not represent a good starting point to examine the relation between the contents of cognition and the contents of perception.

I will then argue with Campbell that information processing accounts of perception are vital for our understanding of the relation between perception and cognition. Campbell (section 1.3.2, p. 29) observes that identifying the phenomenal content of perceptual experience with either non-conceptual (information processing content) or conceptual content does not explain the special phenomenology of visual experience. He suggests that phenomenal, informational and conceptual are three irreducible forms of content the interdependence of which ought to be examined. In order to account for the constitutive elements of perceptual content, information processing accounts should be reconsidered and brought into the focus again. The actual issue concerning the relation of perceptual and conceptual content then can be reformulated in information-processing terms as the interaction of input-driven and intention-driven processing streams.

Finally, in reply to McDowell's objection that non-conceptual contents cannot play a representational role, I will show with Bermúdez (section 1.3.3, p. 33) that subpersonal level information processing stages of perception can have content and that visual experiences can represent the world albeit having non-conceptual content.

In section 1.4, I will discuss an alternative approach to vision by O'Regan and Noë (2001) in which visual awareness, the phenomenology of visual experience, is explained as a function of sensorimotor contingencies. This account emphasizes

the role of explorative behavior and thereby tries to sketch a non-representationalist account of perception. It has received a lot of attention, however, to my understanding, it contains some serious flaws.

The initial question about the ability to recognize objects will thus be embedded in the larger discussion about the relation between the contents of perception and the contents of cognition.

At the end of this chapter, I will provide a sketch concerning the demands an approach to object recognition must meet, thereby setting the stage for the three-stage model of perception developed in chapter three.

1.1 The relation between perception and cognition

Evans' (1982) approach towards an explanation of how perception can make a thought of a certain kind possible, such as »this *x* is a tomato«, consists in an analysis of the triad among perceiving, believing (or thinking) and behaving (or acting).

His model – in its simplest form – looks like this: subpersonal-level information processing leads to conscious perceptual experience; this serves as a screen out of which cognition extracts contents which manifest themselves in the form of thoughts. Perception provides information from the world to the mind; cognition relates the mind to the world by controlling and initiating behavior.

In detail, *perception* is realized by the *informational system* which provides information from the subject's environment. *Thought* is generated by a cognitive system which makes use of the information supplied by the informational system. The link between the informational and the cognitive system is *perceptual experience*. Evans writes:

> [W]e arrive at conscious perceptual experience when sensory input is not only connected to behavioral dispositions […] but also serves as the input to a thinking, concept-applying and reasoning system, so that the subject's thoughts, plans and deliberations are also systematically dependent on the informational properties of the input.
>
> Evans (1982), p. 158.

A subject can be in an informational state without having a corresponding perceptual experience.[1] Evans thus posits a subpersonal level of information processing on the basis of which primitive behavior is possible, as in cases of *blindsight*[2], where subjects are blind due to a brain injury, but are still able to avoid or to

[1] »So far, I have been considering the non-conceptual content of perceptual informational states. Such states are not ipso facto perceptual experiences – that is, states of a conscious subject«, Evans (1982), p. 157.

[2] This phenomenon will be discussed in detail in chapter 3.3.1, p. 78.