Chapter 2
The Misleading Aspects of the Mind/Computer Analogy

The Grounding Problem and the Thorny Issue of Propriosensitive Information

Abstract After the crisis of behaviorism, cognitivism and functionalism became the predominant models in the field of psychology and of philosophy, respectively. Their success is mainly due to the new key they use for interpreting mental processes: the *mind/computer analogy*. On the basis of this analogy, mental operations are seen as cognitive processes based on computations, i.e. on manipulations of abstract symbols which are in turn understood as informational unities (representations). This chapter identifies two main problems with this model. The first is how these symbols can relate to and communicate with perception and thus allow us to identify and classify what we perceive through the senses. Here we limit ourselves to presenting this issue in relation to the classical symbol grounding problem originally put forward by Harnad on the basis of Searle's Chinese room argument. An attempt to address the problem raised here will be made in Chap. 3. The second point we discuss in relation to the *mind/computer analogy* concerns the idea of information it fosters. Indeed, following this analogy, information is something available in the external world which can be captured by the senses and transmitted to the central system without being influenced or modified by the procedures of transmission. This perspective does not take into account that—unlike computers—in living beings information is acquired by means of the body. As Ulric Neisser has already pointed out, the body is itself an informational source that provides us with additional sensory experience that influences (modifies or complements) the information extracted from the external world by the senses. To develop this line of analysis and to determine exactly what information is provided by the body and how this might influence cognition, we examine Sherrington's and Gibson's positions. Moving on from their views, we qualify bodily information in terms of 'proprioception'. We use 'proprioception' in a broad sense to describe any kind of experience we have of our internal states (including postural information as well as sensations related to the general state of the body and its parts). Following Damasio's and Craig's studies, we further elaborate this position, arguing that living beings are equipped with an internal propriosensitive monitoring system which maps all the changes that constantly occur in our body and that give us perceptual ('proprioceptive' or propriosensitive) information about what happens

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inside us. Moreover, relying on Goldie's and Ratcliffe's view, we show that emotional information can also be considered as a form of 'proprioception' which contributes to determining everything we perceive. This analysis leads us to the second main thesis of this book: '*proprioception*' *is a form of internal perception and it is an essential component of the sensory information we can access and use for all cognitive purposes*.

1 The Idea of a Symbol System and the Grounding Problem

Representation is one of the foundational notions in classical cognitive science. Representations are most simply defined as any kind of internal information, organized in a discrete form, that conveys the knowledge an organism has acquired and which serves to orient that organism's subsequent behavior. At the heart of the cognitivist argument is the idea that a capacity to represent the state of affairs of the world is necessary in performing any kind of *intelligent* behavior (see e.g. Varela et al. 1991: 40). As e.g. Jean Mandler suggests:

> Representation is defined most simply as stored information (The terms representation and knowledge can be considered synonymous, but the term representation emphasizes the format in which knowledge is stored). Any organism that takes in information from the world in such a fashion that it influences its later behavior is storing information and so can be said to represent that information. All learning requires storage of information and so requires representation in some form or other (Mandler 1998: 257).

Classical cognitive science focuses mainly on a particular kind of mental representations, i.e. conceptual representations, which are the means humans use to know (to categorize) the external world and thus to organize the information taken from it. These representations allow us to carry out all the high-level cognitive processes we are capable of performing starting with thinking and speaking (i.e. acquiring natural languages).

This notion of representation is understood in relation to the so called *mind/computer analogy*, which both cognitivism and functionalism—i.e. the models of mind that became predominant after the crisis of behaviorism (see Chap. 1)—use to interpret the very concept of mind. As this analogy turns out to offer a powerful explanatory framework, it has become the reference model for many of the investigations dealing with the problem of individuating mental capacities and explaining their functioning. In this perspective, the mind is metaphorically understood as software that works independently of the kind of material (the *hardware*) on which it is implemented, e.g. in the case of human beings, the brain. Mental operations are seen as cognitive processes based on computations, i.e. they are interpreted in terms of manipulations of symbols which are in turn understood as informational unities (representations).

These informational unities or representations are available to the cognitive system thanks to the sensory systems which detect and extract them from stimuli in the external environment. According to the classical cognitive model, after being captured this sensory information is transformed and transmitted to the cognitive system and gives rise to the information the system uses. By virtue of the modularity thesis embraced by the computational view of mind (Fodor 1983; see also Fodor 2000 for an update of the original position and Carruthers 2006 for an extension), the first transformations this information undergoes are rigid: i.e. they are domain-specific (only a limited range of inputs can be computed) and encapsulated (computation is restricted: it cannot be influenced by other modules or by the central system). It is only once this information has been finally transformed into the format of the central system that the modality specific pieces of information can be blended into new amodal informational units whose format is not specific for domain.

On the basis of the metaphor of the mind as a data processor, what serves as input for mental computations can be described in terms of packets of information that are captured by the peripheral, modular systems (one might think this means these information packets are captured by the senses, but this is not accurate because according to the modularity thesis modules are subunits of different sensory modalities—see Fodor 1983, Chap. 3). These inputs then travel through modular channels towards a hypothetical general CPU (i.e. the central system, the true kernel of the computational mind). Thus, the cognitive system works on the one hand with modality specific information units at the level of sensory experience and on the other with amodal information units at the level of the central system where—among other things—semantic processing takes place.

These amodal information units are interpreted in analogy with language as pieces of information that do not depend on any particular sensory modality but can communicate with all of these modalities and that can be identified with a symbol. Just as the word ‘dog’ is not related to dogs through any specific modality, but just refers to dogs, so too the representations in the central system are not related to any specific sensory modality, but codify information about something in the world (e.g. about dogs) in a neutral manner. Moreover, just as the meaning of dog (the informational unit ‘dog’) in natural language is indicated by symbols (D-O-G), so too the informational units in the central system are hypothesized to be identified by symbols. As the form of the symbols that compose the word ‘dog’ does not in any way resemble the form of real dogs (i.e. is not iconic), in the same way mental symbols are hypothesized to be unrelated with the physical and functional features of their referents. They are not bound to the perceptual system: their relation to referents is arbitrary and they do not have any modality-specific properties.

This kind of model was considered to have many advantages: first of all—and this applies in general to all theories of high-level thought—it meets the basic demand of explaining how people can organize the perceptual information they get in an economical and functional manner. In fact, if the information received through the senses were retained in its raw form (i.e. in an interpreted manner), since all perceptual episodes are unique, it would be impossible to match a new perception

with an old one in order to recognize that they were of the same kind and we would need to have an unlimited memory capacity to store every single episode we perceive (Pylyshyn 1973). Secondly, if conceptual representations are amodal symbols, they are not directly related to any kind of (modality specific) perceptual experience and they can therefore neutrally convey and express perceptual information acquired through different sensory modalities. In this way, having the conceptual representation (symbol) of 'chair' does not necessitate having a set of non-linguistic perceptual experiences that can be traced back to the way we experience chairs with the different sensory modalities we are equipped with. It means rather that we have an amodal representation in the mind ('CHAIR') that—much like words in natural language—is arbitrarily linked to the chairs in the external world and whose format does not depend on the perceptible features of these chairs. This view also seems to be particularly parsimonious since concepts can be described as nodes in the central system (or in the semantic memory, as the part of the central system where conceptual representations are stored) which "can be processed simply by accessing the information stored at the type level" (Paivio 1990: 12). Last but not least, being language-like these representations are also compositional: a finite number of symbols can be recombined indefinitely according to specific syntactic rules (see e.g. Fodor and Pylyshyn 1988; Newell and Simon 1972). According to this view, "knowledge is organized propositionally, with the meaning of words emerging from their relations to internal symbols. Determining the meaning of a symbol is like looking up in the dictionary in order to find which definition is given by its relation to other symbols" (Wilson and Foglia 2011; for the discussion of other positive aspects of an amodal code see the next section).

This way of interpreting thought as intrinsically linguistic is, in fact, fairly adequate for explaining adult thought, especially as far as reasoning and higher level cognitive processes are concerned. As e.g. Mandler points out:

> As adults we are so imbued with language that it just seems natural to us that the mind should consist of symbolic representations and their manipulation. There are symbols (roughly words) for each of the objects we can think about. These may or may not be decomposable into parts (e.g. semantic features), but vis-á-vis thinking or reasoning, they are the basic units that are put together to form complex propositions. In this view, thinking consists of manipulating symbols in sentence-like expressions (Mandler 1998: 258).

The identification of thinking with language has sometimes been traced back to a form of Cartesianism (Anderson 2003: 93), since Descartes maintained that only creatures equipped with language—i.e. humans—can 'think' in the proper sense of the word, while other animals are mere physical mechanisms that only have sensations.

> This denial that sensing and acting in the world require thinking, and the concomitant identification of thinking with the higher-order reasoning and abstraction paradigmatically displayed in language use is perhaps the true heart of the Cartesian attitude. Indeed, I believe that it is primarily from this inheritance that the central attitudes and approach of cognitivism can be derived. Simply put, cognitivism is the hypothesis that the central

> functions of mind – of thinking – can be accounted for in terms of the manipulation of symbols according to explicit rules (Anderson 2003: 93).

This idea of thinking as manipulation of symbols has also other advantages in an explanatory framework for cognitivism related to the possibility of offering both a material and mechanical model of thought—i.e. the computer—and a naturalistic explanation of the relationship between brain and mind. The cognitivist thesis is that behavior is caused by representational, *semantically characterized* states like propositional attitudes (beliefs, desires, intentions, and so on). But how is it possible that semantic states can cause the physical changes that are needed to carry out a behavior? Symbolic computation can help solve this issue since symbols are physical, while computations are manipulations of symbols that follow semantic rules. The analogy between thought and symbolic computations can therefore offer a model of how physical causality and semantics can be put together (Pylyshyn 1980). At the same time the relationship between software and hardware offers a naturalistic model of how thought—i.e. the symbol manipulation carried out by a software—can be physically realized in the brain—i.e. in the hardware—without any need to resort to some mysterious form of dualism (for a more detailed explanation of this argument see e.g. Varela et al. 1991: 40ff).

The strict parallelism between mind and computer and the language-like interpretation of conceptual representations that goes with it have many explanatory advantages. This explains why this model has lasted so long and why it continues to be the dominant theoretical model in cognitive research. However, despite its undeniable strength, this view has been criticized from many angles and in recent times it has been *attacked* to an even greater extent. The arguments put forward to challenge this view are numerous. In general, they argue that thought and language cannot be interpreted in a mechanical and formal manner since this does not correspond with the way in which people actually think and speak. More specifically, there are two lines of criticism that we consider to be fundamental and that we will address in this chapter. The first one concerns the link between perception and cognition; we will discuss it is the following part of this section and go back to it in Chap. 3, where we suggest a possible way to overcome the issue. The second one will be discussed in the next sections of this chapter and addresses the abstract and disembodied notion of information derived from the mind/computer analogy that is used to describe the content of representations.

The reason why the link between perception and cognition is often seen as problematic is that we lack a satisfying explanation of how amodal conceptual representations might be formed from perceptual, modal-specific experiences. Indeed, it is quite mysterious how, during its transmission to the central system, information conveyed by the input systems (that provide perceptual, modal information) might be transformed into abstract amodal symbols which lack any specific perceptual characterization and are arbitrarily related to their references. In addition, it is quite mysterious also how amodal symbols might remain connected to perceptual, modal information so that we can always put them in relation to what we perceive through the senses. As e.g. Lawrence Barsalou points out:

> In traditional theories, knowledge consists of amodal symbols that redescribe sensory, motor, and introspective states. […] Traditional theories assume that […] a symbolic system redescribes these states, producing amodal descriptions that reside separately from sensory, motor and introspective systems and that operate according to different principles. For example, sensory, motor, and introspective states could be redescribed as feature lists, networks of propositions, fired sets of productions, instantiated schemata, statistical vectors, and so forth. In all cases, knowledge of the original experience is a redescription in an amodal representation language (Barsalou et al. 2003: 44).

How this redescription works and above all how the redescribed symbols are linked to the perceptual experience they supposedly originate from are unclear. This issue can be made more concrete in at least two main ways. The first one is related to how the models of mind that take inspiration from the computer metaphor explain linguistic learning. As has been pointed out e.g. by Jean Mandler:

> Although it is easy to add new facts via language, there is no obvious way for most such systems to learn information on their own or to generalize their experience. This might be why the topic of learning and organizing knowledge through experience is rarely considered in most symbolic treatments of representations […]. For developmental psychologists, this is a major failing. How can we take seriously any notion of representation in which the learning done by humans from birth is so difficult to specify? (Mandler 1998: 258)

While in the case of the computer, data are explicitly inserted in the appropriate format, in the case of the human being we need to explain how these data can be acquired starting with perceptual experience and what the (genetic and referential) relationship between the symbols and the experience may be (since the symbols must be formed starting from the experience and the experience needs to bestow the symbols with meaning).

The second and better known criticism against the symbolic view of mind is closely related to the first one—it even possibly includes it—and is known as the *Symbol Grounding Problem*. The kernel of this position is the idea that "abstract, arbitrary symbols, such as words, need to be grounded in something other than relations to more abstract arbitrary symbols if any of those symbols are to be meaningful" (Glenberg and Robertson 2000: 381). In its classical version—which is usually traced back to Harnad's 1990 paper—the *Symbol Grounding Problem* is presented on the basis of arguments which related more or less directly back to Searle's Chinese room argument (Searle 1980).[1] Searle's argument is aimed to challenge the principle that—if a computer passes the so-called Turing test (Turing 1950), i.e. can respond with correct symbols strings in a natural language to other symbols strings in the same language so that its answers are indistinguishable from those that a human being might have given—than the computer understands that natural language.

Very briefly, Searle's argument relies on a thought experiment involving an English speaking person who doesn't have a clue about Chinese. This person is

[1]For another well-known interpretation of Searle's argument in the light of the symbol grounding problem which however suggests—differently from Harnad—that we completely abandon a formal model of cognition: Thompson (1997).

closed into a room and has an instruction manual (written in English) that explains how to respond to certain Chinese symbols with other Chinese symbols. Using these instructions, the English speaker is able to write on a piece of paper the correct answer to the symbol strings that Chinese people outside the room pass him through a slot. Since his answer appears reasonable to them and they don't know about the instruction manual, they assume the person inside the room understands Chinese, even though all s/he does (and all s/he knows how to do) is copy some symbols strings associated with other symbols strings according to specific instructions. According to Searle, the person closed in the room is—exactly like a computer—only manipulating symbols according to some syntactic rule, which itself only relies on the shape of the symbol; however, both the English speaker in the example and the computer do not have any understanding of the meaning of the symbols they are manipulating. The symbols are meaningful only for the people *outside* the room and *outside* the computer who interpret the answer both of the person closed on the room and of the computer. Therefore—this is Harnad's conclusion—*the interpretation is not intrinsic to the symbol, but depends on the fact that symbols are intrinsically meaningful for people who know the language* (Harnad 1990: 338–339).[2]

Starting from this conclusion, Harnad defines two versions of the *Symbol Grounding Problem*:

> one difficult, and one, I think, impossible. The difficult version is: Suppose you had to learn Chinese as a second language and the only source of information you had was a Chinese/Chinese dictionary. The trip through the dictionary would amount to a merry-go-round, passing endlessly from one meaningless symbol or symbol-string (the definiens) to another (the definiendum), never coming to a halt on what anything meant […]. The only reason cryptologists of ancient languages and secret codes seem to be able to successfully accomplish something very like this is that their efforts are grounded in a first language and in real world experience and knowledge. The second variant of the dictionary-go-round, however, goes far beyond the conceivable resources of cryptology: Suppose you had to learn Chinese as a first language and the only source of information you had was a Chinese/Chinese dictionary! This is more like the actual task faced by a purely symbolic model of the mind: How can you ever get off the symbol/symbol merry-go round? How is symbol meaning to be grounded in something other than just more meaningless symbols? This is the symbol grounding problem (Harnad 1990: 339–340).

In Harnad's view, the solution that symbolists usually offer for the problem that the central system seems to be merely "hooked up to peripheral devices" (Harnad 1990: 340) only trivializes the nature of the problem itself. He maintains that—in order to deal with the grounding problem—one must give an explanation of the relationship between representations and external world that allow us to account for the human capacity to discriminate among the instances of the external world and to identify them. And to achieve this aim, we need to assume that *some elementary, primary representations* have a nonarbitrary shape, are iconic, i.e. they are sensory and nonsymbolic, while higher-order symbols are composed out of them.

[2]For a recent review of Searle's and Harnad's arguments see e.g. Rodríguez et al. (2012).

> According to the model being proposed here, our ability to discriminate inputs depends on our forming iconic representations of them (Harnad 1987). These are internal analog transforms of the projections of distal objects on our sensory surfaces (Shepard and Cooper 1982). […] For identification, icons must be selectively reduced to those invariant features of the sensory projection that will reliably distinguish a member of a category from any nonmembers with which it could be confused. Let us call the output of this category-specific feature detector the categorical representation. […] both iconic and categorical representations are […] sensory and nonsymbolic (Harnad 1990: 342).

In Harnad's classical version the symbol grounding problem takes a 'compositional form' in the sense that not all the representations must be conceived as perceptually grounded, but only an elementary subset of these which serve as basis to build all the others. Independently of whether only some basic concepts need to be grounded in experience (as Harnad's compositional model suggests) or whether all concepts need to be somehow linked to experience, the question that needs to be addressed is what does this 'grounding' exactly consist of: i.e. under what condition can one say that the knowledge of a concept is grounded in experience (for an overview on this discussion see e.g. Shapiro 2011, Chap. 4; Gibbs 2005, Chap. 4). As e.g. Michael Anderson clarifies:

> Grounding the symbol for 'chair', for instance, involves both the reliable detection of chairs, and also the appropriate reactions to them. These are not unrelated; 'chair' is not a concept definable in terms of a set of objective features, but denotes a certain kind of thing for sitting. Thus is it possible for someone to ask, presenting a tree stump in a favorite part of the woods, "Do you like my reading chair?" and be understood. An agent who has grounded the concept 'chair' can *see* that the stump is a thing for sitting, and is therefore (despite the dearth of objective similarities to the barcalounger in the living room, and despite also being a tree stump) a chair. Simply having stored the fact that a chair is for sitting is surely not sufficient ground for this latter capacity. The agent must know what sitting is and be able to systematically relate that knowledge to the perceived scene, and thereby see what things (even if non-standardly) afford sitting (Anderson 2003: 101–102).

The descriptions of the concepts—this is the point made by Anderson—are usually given linguistically in the terms of the features of the categorized objects, most often of their form and function (when we need e.g. to give a description of the characteristics that an object needs to have to be classified as a chair, we usually mention features like legs, seatback, seat, it is used to sit on, etc.). However, knowing a concept (mastering e.g. the concept of 'chair') requires a set of perceptual experiences concerning the objects and our interactions with them that go far beyond these features. To put this in different terms, to list a set of relevant features and to assign to each of them a specific weight in the categorization judgment, as many quasi-computational approaches to categorization do, is far from being sufficient to explain how categorization is carried out. To explain categorization, we need first of all to clarify how people come to individuate and to select these features on the basis of their perceptual experience; i.e. how these features relate to their perceptual experience.

We will address this problem in Chap. 3. Here we will argue that representations in the central system—i.e. conceptual representations—cannot be *entirely* neutral (amodal) and featural (we will say 'inferential'); and that they must rely also on a

perceptual component, which can be more or less predominant depending on the kind of concepts we are considering. In Chap. 3, we will suggest a hypothesis as to how this perceptual information might be organized so that it can offer a link and constitute a bridge between cognition and perceptual episodes.

2 Representations and Bodily Interferences in Information

As we have already mentioned several times, the notion of representation is one of the fundamental elements in understanding how cognitivism and functionalism view the nature and the acquisition of knowledge. Representations are conceived as symbolic entities of *virtual and abstract character* which convey a *content*. This content is the basic material for the mental operations humans use to develop all kinds of knowledge and the material they use to organize their behavior. This content is essentially viewed as consisting of *information* (Gardner 1985: 38–39). In a cognitivist and functionalist perspective, information is the 'matter' representations are made of. Its function is to get the organism acquainted with the features of its environment and to mediate its behavioral responses to this environment. In this sense, clarifying exactly how this information is interpreted, what it conveys and how it is generated, constitutes an indispensable step for the understanding of both the notion of representation developed in these lines of research and the nature of the mental processes they hypothesize.

The notion of information has its roots in the classical, Greek and Latin philosophical tradition. In a nutshell, in order to explain how the mind could produce thoughts whose content was about objects or entities in the external world, the tradition hypothesized the existence of something that could cross the boundaries of the mind, pass from the outside to the inside and allow the mind to somehow relate (physically and ideally) with the world. This something was called an *intelligible form* (i.e. a form that can be grasped by the mind) (von Borman et al. 1972). *Intelligible forms* were the specific elements through which human beings could think of the objects since they were the only component of these objects that could be *mentalized*, i.e. captured and introjected by the mind. Forms could penetrate the mind and modify its states giving rise to others (perceptions, images, thoughts, etc.) (van Steenberghen 1946); functionally, they were signs internal to the mind about something external to it. The cognitivist and functionalist notion of information is analogous to these forms in many respects. As forms, information can also have a direct causal role on the internal states of the mind, determine a change in their internal organization and therefore influence behavior. Information is what conveys the structure of an entity or a property of it to the cognitive system, ensuring the possibility of a relationship between mind and world.

From the perspective of functionalism and cognitivism, the notion of information takes the place of that of the (distal) *stimulus* as this is described by behavioristic

psychology. One of the main reasons why the former substituted the latter is that the distal stimulus—the things and events we perceive in the external world—is something complex that can hardly be decomposed. On the contrary, the notion of information allows us to 'unpack' the aspects included in the distal stimulus and to treat them separately and independently from each other. In this way it is easier to explain how the different aspects or properties are recorded by e.g. different sensory systems and processed through various operations depending on their configuration to obtain as a final result some form of knowledge that is independent from the specific channel it was originally gained by. Think for example of perception: on the basis of the notion on information it is possible to hypothesize that the structural dimension of a complex of modality specific proximal stimulations can be interiorized and processed in a way that is basically independent from the sensory channel through which it was acquired. Information can be captured, transmitted and transformed because it is translated into a unitary code which is common for the whole system. In this respect, this notion of information diverges from that of form, because the form is extracted from the objects and reproduces some of the characteristics they have in a modal specific way, i.e. in a way that depends on the sensory channel through which it was extracted.

From this perspective, the idea of a unitary code of information has various advantages: all we know about the world is conceived as being codified in an ordinate and limited sequence of simple signals and the contents we learn lose their specificity in the sense that the signs that describe them do not have isomorphic properties and do not 'resemble' the contents they are about. Furthermore, the unitary code accounts for the fact that our knowledge is built in a homogenous manner: all the parts of the system work on the basis of the same code which can be shared by them and transmitted among them without barriers. The cognitive system can therefore be described as a system of transmission, processing and storing of 'matter' that is amodal, i.e. independent of the modalities through which it was acquired and neutral with respect to all of them. From this perspective, it is not relevant through which channel we learn about an object in the external world. Indeed, all the information gained through the sensory channels is codified in this amodal and neutral manner and made available for storing and further processing. This clarifies the operational sense of the mind/software analogy which cognitive psychology and philosophical functionalism rely on. The mind is conceived as the program of an electronic calculator; the mind contents are interpreted by analogy with the inputs of the programs; thought is viewed in terms of computations on symbols while the various operations thoughts consist of are parts of these computations; finally, behavior is seen as the output of the program, i.e. as the result of the calculator processing.

The idea that thought and its operations can be described on the basis of a purely formal model derives from some seminal ideas suggested in the first half of the 20th century by the English logician and mathematician Alan Turing (Gardner 1985: 17ff; Pratt 1987: 177ff). Turing hypothesized the possibility of codifying in a very simple way—through a binary code—the instructions that allow a (virtual) machine to carry out an indefinite number of operations in a finite number of steps (Turing

1936). Turing realized that it was possible to translate tasks of any kind, even complex ones, into sequences of calculations on ideal objects, where the rules for the calculations and the entities that were calculated could be expressed though sequences of signals belonging to a unitary, very simple code. According to Turing, any task could be realized in this way once the operations this consisted of were expressed in an ordinate, clear and finite sequence. It was Turing himself who thought that these principles could be applied to psychology (Hodges 1983: 290), giving rise to an operational model capable of simulating human thought as a process made up of a sequence of rules for computationally operating on symbols and of the symbols themselves which also consist of limited series of signals written in the same code as the rules. Intelligence and more generally thought could be entirely described as a series of virtual operations of this kind (Turing 1950).

Applying Turing's theses on psychology appeared reasonable due to developments in biology and physiology between the end of the 19th and the beginning of the 20th century in particular the idea that living things are entities consisting of very simple mechanisms governed by an imminent teleology, i.e. directed at achieving the aim of survival. Organisms are systemic organizations characterized by performances of growing complexity which are capable of generating and maintaining a certain degree of internal balance, even though they interact with an external environment that is continually changing (Pratt 1987: 179–180). This view of living organisms raised the question of how the execution of operations that are widely different from each other in their nature and level of complexity might lead to behaviors that appear to be simple and congruent. The coherence of behavioral reaction—the fact that the organism can generate coherence through the coordination of the activities of its parts—attracted the attention of researchers. To understand how this is realized, we need to comprehend how the organism coordinates its parts: the simplest hypothesis is that there is a control center in the brain which can unify and use all the information coming from these parts.

Turing's seminal work offers a crucial element to address this issue, i.e. it shows a possible way to describe a process (a flow of information) in a simple manner and with a unitary code which could also possibly be applied to the way in which the organism executes its operations. This idea was corroborated by Charles Sherrington's discovery in 1879 about how nerve cells, including brain cells, communicate: they exchange signals emitted by distinct entities, i.e. different cells, that are captured after they pass through the intercellular space (Robinson 2001: 32ff). This seemed to be consistent with Turing's idea and corroborated the view that this transmission can be described as a process that occurs in a discrete manner involving a finite number of entities and steps. In this vein, the work of the brain could be compared with that of a computing machine with a finite number of states (Pratt 1987: 232). The exchange of signals itself could be described using a formal and simple code like the one hypothesized by Turing (McCullogh and Pitts 1943) and this gave a decisive boost to the further development of the analogy between an artificial computational machine and an organism viewed as a complex of parts coordinated by communication channels (the nervous system) and a control center (the brain).

These investigations gave rise to others in which Norbert Wiener played one of the leading roles. These developments relied on the idea that the study of communication techniques as techniques for the transmission of the messages would represent a new frontier in the comprehension of the way in which organisms give rise to and control their behaviors (on this see e.g. Rosenblueth et al. 1943). These intuitions form the basis of *cybernetics*—a field of study that concerns communication and communication control in animals (including humans) and in artificial agents (Wiener [1948] 1961; Linguiti 1980)—whose aim is to look for a synthesis between the results for information communication obtained from artificial and from biological systems.

From an epistemological point of view, it is important to observe how the interest in the issue of how the internal parts of the system communicate is focused on a particular view of communication as a technique of transmission of a message between two poles: the one that transmit the information and the one that receives it. The general reference point for developing this perspective was Claude Shannon's theory of communication as the discrete transmission of information—a theory developed in the field of telecommunication engineering which was at the time one of the most advanced approaches in this area. The focus of Shannon's theory is on engineering issues: the only aspects of information transmission it considers are those which are relevant for telecommunication. Thus, the research that used this theory as a basis for understanding how the cognitive system works were led to concentrate only on specific issues about information transmission in biological systems, specifically, issues that were borrowed from Shannon's theory such as whether (and how) the information transmitted inside the cognitive system remains identical to itself or whether it undergoes some change during transmission from one to another area or whether the organism has a system of continuous or discrete reception of signals. Other kinds of questions that were not relevant for a theory of information transmission in telecommunications—mainly issues concerning where the information the organisms have originates from—were by contrast completely overlooked. This had relevant theoretical consequences for the study of the cognitive system, since the lack of interest in these latter questions lead researchers to neglect the limits of Shannon's ideas when applied to psychological and philosophical research on mind.

In line with Turing's ideas, Shannon developed a very simple system for the transmission of a message (content); this message was interpreted as an ordinate sequence of signals in a code which could be interpreted (decoded) by the circuits of an electronic device. In this view, the notion of *message*, meant as *information to be transmitted*, is conceived as something that is codified in a very simple manner and that is transferred through mechanical operations in a way that is neither affected by the semantics (the content) of the message nor affects it in any way. Shannon was trying to solve a theoretical and technical problem in engineering telecommunications at a distance for techniques such as telegraphy and telephony, i.e. how to convey content across a channel without altering this content; thereby allowing the recipient to get the same 'object' transmitted by the sender. The point of this research was to find the best *means* possible to transmit information leaving

the signal intact—without affecting or modifying it in any way. To achieve this aim, the content must be decomposed into its minimal constituents when it is transmitted and then it must be recomposed at reception so that its initial structure is perfectly reproduced. The transmission must not alter the message or change/affect its structure. According to Shannon, communication is *effective* when it allows information to be transmitted in the *purest* manner possible, i.e. with the lowest possible degree of distortion (avoiding so-called "ground noise") that can be caused by the physical characteristics of the transmission channels.

The model at the base of this idea is communication via a telephone. Shannon's specific aim was to develop a mathematical description of the communicative process suitable for improving engineering techniques for the construction of transmission systems with a degree of distortion close to zero. From this perspective, the ideal code should not be sensitive to either the semantic characteristics of the message or the physical characteristics of the system of information transmission. For this reason, this code must be as simple as possible in order to guarantee successful communication, i.e. to assure that the message remains identical when transmitted from the sender to the recipient. As Shannon effectively summarizes:

> the fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is, they refer to or are correlated according to some system with certain physical or conceptual entities. *These semantic aspects of communication are irrelevant to the engineering problem*. The significant aspect is that the actual message is one selected from a set of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of the design (Shannon 1948: 379).

In Shannon's view, the message is *not* something that is constituted during the process of communication, since this process has a basically *instrumental nature* and is understood as a *passive transmission of information*: the sender transmits a message in a code and this must come to the recipient in such a way as to allow identification as fast and as effective as possible. To have *effective* communication, the message needs to be encapsulated in a simple and universal code. In this perspective, information is just what the code conveys through its abstract and formal sequences of symbols. According to Shannon, good information transmission also requires that the signal be sent in a *discrete*—i.e. *not continuous*—manner, because the transmission is effective only when the information is conveyed precisely piece after piece through a limited number of sending operations. This allows the decoding systems to discriminate the signal that carries the original information from other extraneous signals. In fact, Shannon's idea of code is built on the notion of the 'bit' (the basic unit of information in computing and digital communications) and on the quantity of transferable 'bits'.

To summarize, Shannon's view has relevant operational presuppositions: first of all, the message is extraneous to the system that allows for its communication; secondly, this communication consists in the mere transmission of signals (information) between two poles and it does not alter the structure of the information (of

the message) conveyed; thirdly, the message itself is indifferent with respect to its communication: the communication as transmission of information must be insensitive with respect to the content that is transmitted. The process consists of a purely formal operation that is not sensitive with respect to its content.

The application of information theory to psychological models played a crucial role with respect to the theories of mental processes based on the human/machine analogy, especially those that considered the mind to be a software with the capacity to transmit and process available information. Applying a notion of information derived from computer data processing to human cognition is not unproblematic and has been criticized since it was first proposed. First of all, in this model information is considered to be something real and to originate from a source external to the subject and to be independent of him/her. Secondly, this idea of information is characterized by a too high degree of abstraction (Tallis 2004: 54–62; Gardner 1985: 384ff). These two features are actually two sides of the same coin; thus, they can be considered jointly. In particular, *they are both the effect of an aseptic and disembodied conception of information which leads to an aseptic and disembodied view of mind* (Wallace et al. 2007).

According to the standard computational model, the information the cognitive system works on is derived uniquely from the environment external to the perceiving subject: information is something available in the external world which can be detected (captured and grasped) by the senses. The senses on the other hand are understood in the classical manner: in line with the standard view that become predominant in the Western tradition, our sensory experience is considered to be characterized by information provided exclusively by the five senses. This information is hypothesized to be transmitted from the senses to the central system without being influenced or modified by the procedures of its transmission and transduction. This view is *aseptic* because it suggests that the information the cognitive system works on is something abstract that can be transmitted by the cognitive system without being 'contaminated' in any way by the processing itself. Moreover, this perspective is also *disembodied* because it suggests that the information our cognitive processes rely on is external to the subject and it consists in the external environment. As a consequence, the body is not considered as an informational source that provides us with additional sensory experience that influences (modifies or complements) the information driven from the external world by the senses.

These possibly misleading aspects of the rising trend towards a computational model of mind in cognitive psychology were already pointed out and addressed by one of the grounding fathers of cognitivism: Ulrich Neisser. Neisser was certainly attracted by the theoretical potential of the mind/computer analogy that gained strength during the sixties. However, he was also aware of the limits of this perspective, even though for a long time his critiques were not followed up. An overview of Neisser's position can already be found at the beginning of one of his fundamental works—*Cognitive Psychology* (Neisser 1967)—in which Neisser offers one of the first and most significant systematizations of the rising cognitivist approach in psychology.

Neisser challenges Shannon's view. He addresses one of the most relevant applications of Shannon theories, i.e. telecommunications and in particular communication by telephone, in order to show that this model is not appropriate for understanding both the (external) communication processes among humans and the (internal) dynamics of information transmission and processing carried out by the cognitive system through perception and thought. Unlike telecommunications in which some informational units are conveyed by neutral and unselective channels without modifying or influencing the object of transmission, in Neisser's view, human communication is not a discrete and passive process through which signals are transmitted from a sender to a recipient. Rather, this is an active process continuously characterized by feedback and by the selection of information that constantly adjusts the interaction between sender and recipient. As Neisser points out at this respect: "a telephone cannot decide which portion of the incoming message is relevant […] human beings behave very differently, and are by no means neutral or passive toward the incoming information […] they select some parts for attention at the expense of others, recoding and reformulating them in complex ways" (Neisser 1967: 7). For this reason, the metaphor of formal communication does not apply to human communication; moreover, the elements that mediate human communication cannot be understood in the formal and abstract terms postulated by Shannon's theory.

The same limitations identified for the application of this metaphor to external communication also apply to its usefulness for explaining internal cognitive processes (i.e. the transmission of information from its acquisition by the senses through the various steps of its processing and from one part of the system to another by analogy with software operations). Indeed, in Shannon's model the input and output information is equipollent and the transmission does not influence the content of the message. In this way, the organism would be nothing but a neutral and passive transmitter of information that takes information from the external world, decomposes it for transmission and recomposes it in the original form.

The starting point of Neisser's position is exactly that this is not what happens in humans and more generally in 'living' cognitive systems. Indeed, such systems have no direct access to the external world: what they experience are constructions produced by their own minds, and specifically by their cognitive systems, through the transformation of the information drawn from the external world. In Neisser's words:

> Whatever we know about reality has been mediated not only by the organs of sense but by complex systems which interpret and reinterpret sensory information. The activity of the cognitive systems results in – and is integrated with – the activity of muscles and glands that we call "behavior". It is also partially – very partially – reflected in those private experiences of seeing, hearing, imaging, and thinking to which verbal descriptions never do full justice (Neisser 1967: 3).

The cognitive activities of subjects are described by Neisser using a phrase that rephrases the title of a well-known Freudian work (*Instincts and Their Vicissitudes*): *Stimulus Information and its Vicissitudes* (Neisser 1967: 4). In his work Freud tries

to describe the motivational dynamics of human behavior using the notion of instinct; in a similar vein, Neisser's motto sketches the dynamics of our cognitive processes based on ongoing information processing, i.e. on an everlasting transformation of information. In Neisser's view, the very idea of cognition is defined by these dynamics: "the term 'cognition' refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used" (Neisser 1967: 4). Thus, information is continuously transformed and this transformation cannot be conceived as completely independent from the physical—concrete and material (i.e. bodily)—dimension of human beings. The originality of Neisser's work consists in its focus on the bodily component as something that plays an active role in the detection and in the processing of information. From Neisser's point of view, *information cannot be understood as aseptic and disembodied, i.e. as independent and separated from the body, since the body is the means by which information is processed*.

Examined in its entirety, the position expressed by Neisser opens an issue that involves the very concept of information on which cognitive psychology is grounded. Neisser's criticism challenges the idea that the mind/computer (or more generally the human/machine) analogy can be applied to psychology in a strict and rigid manner.[3] Neisser tries to develop a different view of the human cognitive system: even though he relies on the metaphor of cognition as information processing, and considers it an essential element in understanding how the mind works, he also argues that the cognitive system is not merely passive but constantly acts on the information input modifying and influencing it during processing. At the same time, the process of information acquisition cannot be considered a neutral reception of signals as per Shannon's theory.

Neisser's criticism of a purely computational notion of information can be considered the first attempt internal to the cognitive perspective to explain perception and cognition as complex processes carried out by living organisms, i.e. by living bodies that do not merely detect and receive external stimuli, but also actively and dynamically produce information that can then be used by the cognitive system for further processing. Unlike Shannon, Neisser is persuaded that our cognitive activities cannot be properly understood if we neglect the issue of the origin of the information we process and do not investigate where and how this information originates.

Since bodily processes are actively involved in perceptual experience, according to Neisser this bodily information must be taken into consideration as an essential part of the stimuli our cognition works on. Bodily information is a kind of perceptual information that does not originate from the external objects people perceive, but from their own body which is the condition of possibility for perception itself as well as the non-neutral means through which perception is gained. To get

[3]In particular, Neisser expresses strong skepticism about the general idea that the study of formal and computational processes can help us understand specific aspects of human behavior such as emotions: "Unlike men, 'artificially intelligent' programs tend to be single-minded, undistractable, and unemotional" (Neisser 1967: 9).

information on the external world requires, among other things, to know what is 'external' and what is not as well as be able to distinguish an external from an internal environment. This knowledge also allows one, among other things, to be aware of the fact that it is s/he and not someone else who perceives things.

Even though Neisser's view on this in more a suggestion than a fully developed theory, he alerts the rising cognitive research movement of the need to reconsider what information the cognitive system works on, specifically taking into account that information must be acquired by means of the body. His legacy is an essential step towards a reconsideration of the structure of cognitive science that overcomes the limits of the mind/computer analogy and reassigns a proper role to bodily information in any explanation of how information processing in living organisms might actually work.

3 The Body as Information Source: Gibson's Hypothesis of an Integrated Perceptual and Propriosensitive System

Charles Sherrington is the first author who develops a comprehensive and systematic view on the function played by *all* the sensory information we can access, including internal information, with respect to our perception and our perceptual knowledge of the world and of ourselves. Indeed, the studies he carried out between the end of the 19th and the beginning of the 20th century radically modified earlier conceptions of the sensory experience and its composition. Sherrington hypothesizes that the human body as a whole is itself a source of stimuli that can give rise to specific sensations which directly or indirectly contribute to the complex of knowledge we have about the world and ourselves. Bodily information is collected through particular receptors that are—like any other kind of receptors—highly specialized for specific kinds of stimuli.

The attention devoted by Sherrington to internal sensations does not imply that he believed internal sensations to be more important than external perception. Indeed, Sherrington continued to consider the classical five senses—sight, hearing, smell, taste and touch—to be *special senses* (Sherrington 1906). They are described as selectively and mechanically sensitive to a unique, specific kind of information which is available in the external environment: light for sight (more specifically for the retina), soundwaves for hearing (more specifically for the cochlea), etc. However, in his view external stimulation is no longer considered to be the *sole* source of information living organisms have access to. In fact, in addition to the receptors positioned in the organs of sight, hearing, smell, taste and touch, we also have other kinds of receptors with a comparable level of specificity which are positioned deep in the body and along its surface and are directed outwards and inwards. If we consider them in their complexity, these constitute a sensory field that cannot be disregarded when we discuss the origin and nature of our perceptual knowledge.

> The main fields of distribution of the receptor organs fundamentally distinguishable seem, therefore, to be two, namely, a *surface* field constituted by the surface layer of the organism, and a *deep* field constituted by the tissues of the organism beneath the surface sheet […] But the surface field is further broadly subdivisible. Its subdivisions are two. Of these one lies freely open to the numberless vicissitudes and agencies of the environment; it is co-extensive with the so-called external surface of the animal. It is cutaneous in the widest sense of that term. It possesses as receptive organs not only those of touch, & c., in the skin proper, but also the eye, nose, and organ of hearing. This subdivision of the surface field contrasts with a second subdivision of it, constituted by what is commonly termed the internal surface of the animal, the alimentary or intestinal surface. This latter surface is, it is true, in contact with the environment; but the environment with which it is in contact is a portion of the environment greatly modified from the general environment outside by lying almost completely surrounded by the animal itself. This part of the receptive field of the animal's surface, which is turned inward upon the alimentary contents, may be termed the *intero-ceptive*, in contradistinction to that larger part of the surface which looks outward upon the free environment in general, and the latter may from that circumstance be termed the animal's *extero-ceptive* surface (Sherrington 1907: 469).

With the term *exteroception* Sherrington indicates all the receptors of the special senses (i.e. the classical five senses) as well as other kinds of receptors that are located along the surface of the skin and are directed outwards like e.g. the thermoreceptors (which are sensible for variations in temperature) or the nociceptors (which are sensible for variations in stimuli which are responsible for the feeling of pain). Exteroception is the complex sensory field that results from the conjunction and the integration of all the stimulations captured by these receptors. This represents the widest and most intuitive domain of our sensory experience. Maybe for this reason exteroception (i.e. sensory experience due to stimuli coming from the external word) was considered for a long time to be the most important, if not the only information organisms relied on to form their perceptual knowledge of the world.

> the *extero-ceptive* field, which is most rich in receptive organs, both as regards number and variety. For this to be the case, is in accord with what might be expected. It is this *extero-ceptive* field which, facing outward on the general environment, receives and has received for countless ages the full stream of all the varied agencies for ever pouring on it freely from the outside world (Sherrington 1907: 469).

Nevertheless, in addition to exteroception, through their receptors organisms can also capture other kinds of information. Indeed, according to Sherrington if we consider the internal surface of the organism, we can identify further sources of sensory experience.

First of all, physiological and phenomenal evidence shows that we have another receptive field that is turned inward and captures information on the status of the internal organs and specifically the viscera. Sherrington calls this *interoception*. In his view, interoception captures in particular information on the muscular contractions concerning the voluntary and involuntary muscles related to the internal organs of the body—e.g. the stomach, the intestine etc.

Secondly, there is another kind of internal information organisms can detect which relates to muscular contractions. This is due to receptors which capture the

contractions of the muscles linked to the skeletal apparatus which enable the movements of the body. Sherrington calls this *proprioception*.

> The receptors which lie in the deep tissues appear adapted for excitation by changes going forward in the organism itself. These changes work, it appears, largely through the agency of mass with its mechanical consequences of weight and inertia, and also largely through mechanical strains and alterations of pressure resulting from contractions and relaxations of muscles. Therefore, a character of the stimulations occurring in this deep field is that the stimuli are traceable to actions of the organism itself, and are so in much greater measure than are the stimulations of the surface field of the organism. Since in the deep field the stimuli to the receptors are delivered by the organism itself, the deep receptors may be termed *proprio-ceptors*, and the deep field a field of *proprio-ception* (Sherrington 1907: 471).

Interoception and proprioception are both kinds of perception which detect muscular contractions (movements). However, they differ from each other because they are related with different kinds of muscles. *Proprioception* indicates the information derived by the muscles connected with the skeletal apparatus which gives rise to the sensations we experience in relation with the actions and the movements of the organism while *interoception* designate the information derived by the muscles linked to the internal organ (mostly the viscera) which produce the sensation we experience in relation with e.g. digestion, defecation and analogous.

According to Sherrington, the strength of a signal depends on the number of receptors that capture it: in his view the degree to which we are aware of certain sensations depends on whether they were produced by a higher or lower number of receptors. Since the spread and the number of the interoceptive receptors are lower than those of exteroceptors and proprioceptors, the sensations they give rise to are also less intense (Sherrington 1906: 320) and this is the reason why we are often unaware of them. However, this does not mean that they do not exist or that they are unspecific in terms of their quality and localization.

In Sherrington's view, organisms collect perceptual information from all the three kinds of receptors mentioned. The complex of all stimulation captured by these receptors is centrally integrated by the brain. On the basis of Sherrington's description, our experience is therefore the outcome of a systemic process, i.e. it results from the assembly of all kinds of sensations we experience, not only those produced by exteroception, but also those derived from the internal environment of the organism through proprioception and interoception (Sherrington 1907: 475). These sensations are then 'blended' by the brain and made accessible by consciousness (Sherrington 1906, 1941).

This integration produces, among other things, a coherent and unitary representation of what Sherrington calls the '*material me*', i.e. a representation of the body that integrates posture, position in the environment, affective tones connected to bodily states etc. This representation produces a minimal sense of identity consisting primarily of bodily cohesion, coordination of bodily parts and position in the environment and is supported mainly by motoric information about muscular contractions related to any kind of movement we make, including the acts we carry out to acquire external information through the special senses. In fact, if we reflect

on what is represented by our consciousness, it becomes clear that we are not only aware of the perceptual objects located in the external environment of the organism (and of their corresponding qualities), but we have also a background awareness of the way in which the organism participates with its micro and macro movements to these perceptual acts and to the acquisition of perceptual knowledge. Indeed, external perception is made possible by all the movements of the body and the final result consists in centralized integration by the brain of both the external information and the internal information related to the processes that made it possible to collect this information.

Moreover, the *material me* also relies on information on our affective tones which are detected through the visceral and muscular contractions we experience by the means of interoception and proprioception.[4] "Sensations derived from the body tissues and organs possess strong affective tone; while sensations of special sense are relatively free from affective tone" (Sherrington 1900: 969). Sherrington's *material me* consists therefore in the self-representation everyone has of him/herself as a living organism: this is always accompanied by an affective tone which—being consciously perceived—make us aware of the general state of our organism.

If we overlook Sherrington's metaphysical speculations on why and how his result can be interpreted in the framework of a strong form of Cartesian substance dualism (Bennett and Hacker 2013: 231–236), his theses can be considered as extremely innovative and original for the research on mind. Indeed, they represent one of the firsts systematic attempts to show that bodily experience has an important function to play with respect to the origin of our perceptual experience in its complexity and therefore also of our knowledge. For this reason, in spite of the author's intention, Sherrington's position also contributes to bridging the gap between mind and body. The focus on internal sensation leads to a change in the way we interpret the role played by the body—by the bodily sensations and by our awareness of them (so-called *proprioceptive awareness*, Gallagher 2005)—in relation to the constitution of our perceptual knowledge. In fact, bodily sensations do not only give us information about the body itself, but they also participate in the organization of the complex of our perceptual experience. In this way, the field of perception—which was traditionally considered to be directed outward toward the knowledge of what is external to us—appears to be more extended and integrated, to include also what happens inside the organism. In this way, bodily information acquires an epistemic dignity that it never had before.

Sherrington's discoveries on the proprioceptive and interoceptive receptors show that our body is organized in a way that enables it to capture signals of what happens outside and inside it and to distinguish between them (see Evarts 1981: 44–45). The description Sherrington offers of this distinction is more detailed and systematic than any other developed in previous philosophical, physiological,

[4]As we anticipate already in Chap 1, Sect. 3 discussing behaviorism and as we will clarify in more specificity below (Chap. 5), emotional states are closely related to bodily modifications such as visceral and muscular contractions.

anatomical and psychological research (see Sherrington 1906). Sherrington's research radically changes the way we can consider the relationships occurring between the complex of the sensations we experience and the constitution of the perceptions we are aware of and use for the development of knowledge. His anatomical and physiological studies lead us to reconsider what happens inside the body—mostly below the threshold of consciousness and of attention, including it in the organism's perceptual field. In fact, *the findings on propriocepton and interoception and on their functions progressively invalidates the (long-lasting) conviction of the philosophical and psychological tradition that the body plays a passive role in the constitution of perceptual objects and knowledge in general*. According to this tradition, perception is essentially something through which we capture information about the world outside our skin and is the result of the organization of the sensory stimuli carried out under the guidance of intellectual functions, while bodily experience plays a marginal or even no role in this information acquisition and processing.

The line of development of Sherrington's research that is most relevant in the context of this study is that conducted by James J. Gibson. Taken as a whole, *Gibson's work can be considered as a particularly original attempt to improve Sherrington's research on internal sensations as forms of perception which leads also to a conceptual reunification of the distinction between proprioception and interoception*. In fact, initially Gibson was skeptical towards Sherrington's distinction between exteroception, proprioception and interoception and especially towards the idea that we have any kind of interoceptive experience at all ("interoceptors […] if they exist in physiological fact, they are not yet understood"—Gibson [1961] 1987). However, a few years later Gibson revisited this characterization and maintained that to account for perception we do need to consider all the kinds of information mentioned by Sherrington. In fact, *he suggests that we should not focus so much on them separately, but we should rather consider their joint contribution* (Gibson [1975] 1987). In his view, Sherrington's distinction should be simplified and traced back to two kind of experiences only, which are respectively external and internal: "Simplifying a distinction made by Sherrington, I propose to use the term perception for an experience of the environment surrounding the body of an animal and the term proprioception for an experience of the body itself" (Gibson [1968] 1987).[5]

The reason why he argues that we should extend the notion of proprioception to also include interoception (i.e. to include all the kinds of perception that keep track

[5]According to Gibson, all bodily sensations are perceptions of the same kind. Gibson welcomes the notion of '*somaethesis*' introduced by Boring (1942), which encompass 'tactual sensibility', 'organic sensibility', 'kinesthesis', feelings of 'pressure', 'muscle tension', 'pain' and 'temperature'. In fact, he considers all these experiences to be part of the same complex perceptual system: "the feelings of the body were so much allied as to be subsumed under one name" (Gibson [1966] 1983: 98). In this sense, in Gibson's view, "Boring's somaesthesis […] includes Sherrington's interoception" (Gibson [1968] 1987). On current philosophical developments concerning *somaesthesis* see Shusterman 2008, 2012.

of what happens in the internal environment of the body where we are directly aware of them or they are only implicitly present) lies in the innovative perspective of perception he puts forward. Gibson maintains that perception does not consist in a passive recording of stimuli, but is rather a complex '*activity*' involving the organism considered as a whole, hence both the 'external' and the 'internal' environment. This activity is an integrated process whose outcome does not depend so much on what sources information originally comes from, but rather on how these various kinds of information interact and are merged together to give rise to our overall experience. In Gibson's view, perception is the result of a synthetic construction which results from an *unbroken flow* of signal exchanges between different organs that are *always in reciprocal relations*. Even though what we perceive appears to us as an organically structured unity, it is actually neither unitary nor simple. At least its formation is not like this. What we define as perception is a mode of our overt attention (Gibson [1966] 1983: 47–58): it is the final result of an active perceptual processing, but it does not reveal anything about the actual process of perceiving: "Perceiving is an achievement of the individual, not an appearance in the theater of his consciousness" (Gibson [1979] 1986: 239).

The studies on the physiology of perception that went back to Sherrington relied on the idea that the sense organs receive stimuli through receptors and these receptors work essentially in a passive way: they are triggered by appropriate stimuli and produce sequences or series of discrete stimulus-information which are then conveyed and processed by the brain to give rise to perceptions. Gibson's view is more complex and it suggests that the content of perception is not determined by one sense or by one organ only, and even less by the receptors which act as the "passive, elementary, anatomical components" of the organs (Gibson [1979] 1986: 53); this is rather the result of the work of a network of organs (and receptors) called the *perceptual system*. A system is a set of highly organized elements that are steadily in reciprocal contact and interaction (Gibson [1966] 1983: 42). Conceived in this way, the act of perceiving does not result—as Sherrington hypothesized—from a central processing of information collected by peripheral receptors and transmitted in a unidirectional and uniform manner to the brain. Perception is rather the product of a systemic organization of the organs: "A system has organs, whereas a sense has receptors. A system can orient, explore, investigate, adjust, optimize, resonate, extract, and come to an equilibrium, whereas a sense cannot" (Gibson [1979] 1986: 245). Gibson's point is that the various forms and modalities of perception do not depend on an individual organ, but result from the work of a system of organs that actively collect and select relevant information to execute and preserve the organism's vital functions and to carry out specific actions in a specified environment. What we perceive is not merely the effect of centralized integration (by the brain) of different stimuli coming from the sense organs; it is rather the outcome of a continuous collection and selection of information.

In Gibson's view, *stimulus and information are not one and the same thing*. Information differs from stimulation in various respects. First of all, the stimuli and the receptors that collect them *do not work in a discrete, but in a continuous manner* (Gibson [1966] 1983: 39ff). The receptors do not receive stimuli in an

intermittent way, moment after moment; they are not active only '*in stop and starts*', but they are steadily in a state of solicitation because the environment that produces stimulation is continuously present and changing. Thus, the stimulation is likewise a continuous changing flow which is therefore radically different from information that is conceived as arriving in discrete and stable knowledge units. This leads us to the second remarkable aspect of Gibson's differentiation between stimuli and information. While stimuli are homogeneous and undifferentiated, information is something *relevant* to the subject.

In spite of these differences, stimuli and information are also clearly related to each other. Gibson conceives of information as having a 'differential value': we call 'information' the differences in intensity in the flow of the stimuli. It is this difference in intensity of stimulation that makes it possible for certain stimuli to become salient for perception and thus to be actually perceived (i.e. to reach our awareness as perceptible objects). To give an example taken from visual perception (the field Gibson mostly works on), contrary to Sherrington's hypothesis, the salient information captured by the retina does not consist in the light waves light is composed of. In fact, light and light waves are continuously captured by the ocular photoreceptors. What we actually perceive—what is salient to us and constitutes the information we get from the environment—are the *differences* among various kinds of light waves which are present in the environment and are refracted by objects. If we were in an environment characterized by a constant, intense and homogeneous luminosity, we couldn't distinguish figures, backgrounds, profiles, three-dimensionality, and so on.

Moreover, while the stimuli are something that passively and mechanically hit the receptors, information is something the organism continuously seeks for and selects with the specific intent of actively operating on the external environment. What counts as information is the product of the constant action of the organism in the environment: an organism's life is steadily characterized by micro and macro movements whose outcome is the change of the organism's position and perspective with respect to the environment. A perceptual event that brings about a visual object cannot be the result of an individual sense and of its receptors. It is rather the product of the constant interaction among distinct organs always working together to obtain the best possible conditions to gather information (e.g. when we focus, keep our balance, adjust our posture, etc.). When we see an image, we are not aware of this complex net of information that contributes to constituting it; however, our vision of this image depends on and is made possible by this information complex.

We could never have e.g. visual experiences if vision depended uniquely on the eye and the retina considered in isolation. A much larger part of the organism is involved in the act of vision. Indeed, what allows us to see is the continuous coordination among ocular movements, movements of the head, of the body, contractions in the eye, nervous and cerebral functions. In this sense, what we see is not the product of an individual organ, but of a system of organs which is continuously active and act in reciprocal relation. Even though the main theses developed by Gibson are about vision, he was persuaded that any perception

depends on the work of perceptual systems (Gibson [1966] 1983), which put us in actual and active contact with the world.

> Perceiving […] is a keeping-in-touch with the world, an experiencing of things rather than a having of experiences. It involves awareness-of instead of just awareness. It may be awareness of something in the environment or something in the observer or both at once, but there is no content of awareness independent of that of which one is aware. This is close to the act psychology of the nineteenth century except that perception is not a mental act. Neither is it a bodily act. Perceiving is a psychosomatic act, not of the mind or of the body but of a living observer. The act of picking up information, moreover, is a continuous act, an activity that is ceaseless and unbroken. The sea of energy in which we live flows and changes without sharp breaks. Even the tiny fraction of this energy that affects the receptors in the eyes, ears, nose, mouth, and skin is a flux, not a sequence. […] Discrete percepts, like discrete ideas, are 'as mythical as the Jack of Spades' (Gibson [1979] 1986: 239–240).

This should clarify in which sense perception in Gibson view's is—as we mentioned—an individual's achievement, i.e. a synthetic act in which the perceptual object is built on the basis of a continuous collection of information and then reaches the awareness of the observer. Thus, even though the perceptual objects we are aware of appear to us as simple units, they are actually very complex: they are formed starting from the stimulation collected by a number of receptors and their qualitative characteristics are derived by the senses through which this stimulation was collected.

Gibson's idea of perception is based on a notion of stimulation which differs from the one defined by the previous psychological theories. First of all, in the traditional theories of perception the senses get and transmit stimuli through the activation of sensory receptors positioned along the organism. Such receptors are activated only when the amount of stimulation (energy) they get exceeds a certain threshold. Otherwise they are at rest. In Gibson's view, it would be a mistake to think that perception results ultimately from exceeding a certain stimulation threshold because perceptual awareness does not seem to depend on a stimulus threshold and above all because it does not depend on individual stimuli.

> An application of stimulus energy exceeding the threshold can be said to cause a response of the sensory mechanism, and the response is an effect. But the presence of stimulus information cannot be said to cause perception. Perception is not a response to a stimulus but an act of information pickup. Perception may or may not occur in the presence of information. Perceptual awareness, unlike sensory awareness, does not have any discoverable stimulus threshold (Gibson [1979] 1986: 56–57).

The awareness of the perceptual object is based on information concerning the object itself, but this information is not the same as the individual sensations produced by the receptors. In fact, the specific quality of a sensation depends on the specific channel which it originates from, while the information provided by the perceptual activity consists of a complex of data concerning the source of the stimulation (i.e. its object) as well as its relationship to the perceiver and his actions and movements during perception. The result of perception is not merely information on the external world, but rather information on the external and the internal environment of the observer blended together: to perceive means to be aware of

information concerning both the object and the subject of the perception, so that this information compound reaches awareness as a unity in which the different components cannot be distinguished and taken apart. In this sense, proprioception and exteroception are always complementary and inseparable (see e.g. Gibson [1979] 1986: 116, 151, 183, and 201). As Gibson exemplifies:

> Information exists in a normal ambient array, therefore, to specify the nearness of the parts of the self to the point of observation-first the head, then the body, the limbs, and the extremities. The experience of a central self in the head and a peripheral self in the body is not therefore a mysterious intuition or a philosophical abstraction but has a basis in optical information (Gibson [1979] 1986: 114).

In the traditional psychological and philosophical views, the senses were conceived as unidirectional, simple channels, separated from each other, which serve for the transmission of the stimuli produced by the receptors. On the basis of his notion of perceptual system, Gibson challenges this position and suggests that to understand perception one needs to focus on the whole organism's perceptual activity *and on the blending between exteroceptive and proprioceptive (propriosensitive) information*.

> I maintain that all the perceptual systems are propriosensitive as well as exterosensitive, for they all provide information in their various ways about the observer's activities. The observer's movements usually produce sights and sounds and impressions on the skin along with stimulation of the muscles, the joints, and the inner ear. Accordingly, information that is specific to the self is picked up as such, no matter what sensory nerve is delivering impulses to the brain. The point I wish to make is that information about the self is multiple and that all kinds are picked up concurrently. An individual not only sees himself, he hears his footsteps and his voice, he touches the floor and his tools, and when he touches his own skin he feels both his hand and his skin at the same time. He feels his head turning, his muscles flexing, and his joints bending. He has his own aches, the pressures of his own clothing, the look of his own eyeglasses – in fact, he lives within his own skin (Gibson [1979] 1986: 115).

Thus, in Gibson's view perception is the product of a continuous and not-discrete collection of information on the external and on the internal environment of the perceiver. The perceptual system never stops working. Its task does not merely consist of passively detecting packets of stimuli or plain sensations coming from the various, specific receptors positioned along the body when they are properly activated. "The perceptual capacities of the organism do not lie in discrete anatomical parts of the body but lie in systems with nested functions." (Gibson [1979] 1986: 205) And further: "The established theory that exteroception and proprioception arise when exteroceptors and proprioceptors are stimulated will not do. The doctrine of special channels of sensation corresponding to specific nerve bundles has been abandoned." (Gibson [1979] 1986: 238)

This is one of the most important aspects of Gibson's revision of the notion of proprioception which was originally put forward by Sherrington. As we considered above in this section, with the term *proprioception* Sherrington indicates the specific capacity some receptors have to capture and to transmit a specific kind of

information collected within the organism. To coin the neologism 'proprioception', he puts together the Latin words *proprius* (whose literal meaning is 'own') and the Latin verb *capere* (which can be translated as 'capture') to indicate that the perceptual capacities of the organisms are not only sensible to the stimuli taken from the external world, but they are also able to capture stimuli generated by what happens in their internal environment. These stimuli give rise to specific sensations related to the condition of the body and thus to a form of bodily perception of the organism's acts and muscular movements. As Evarts underlines: "The Latin word *proprius*, meaning *own*, provided a prefix which called attention to the fact that the organism's *own* acts created the adequate stimuli for these receptors" (Evarts 1981: 44). However, in Sherrington's view, not all internal stimuli are considered as proprioceptive since he distinguishes between proprioception and interoception. Proprioception captures motoric information generated by muscle contraction, while interoception captures states related to the internal organs, in particular, to visceral contractions. The sensations produced by these two kinds of receptors are then integrated by the brain in a way that better resembles a juxtaposition then a synthesis.

Gibson's view on this is quite different. He considers perception as the result of the action of systems of organs which are in continuous and incessant activity. In his view this applies not only to external but also to internal perception. Thus, the perception of the internal states of the body is also "an overall function, common to all systems, not a special sense" (Gibson [1966] 1983: 320). For this reason, Gibson does not distinguish between interoception and proprioception, but uses the word 'proprioception' to indicate both kinds of information. To be precise, 'proprioception' means something even more comprehensive: it indicates the continuous contribution of the corporeity of the perceiving subject to perceptual processes; it concerns the way in which the individual explores the world, looks for/selects information and detect/feels the changes that occur inside him/her. Proprioception and proprioceptive (propriosensitive) awareness are more than the background of our perception, they are the condition of possibility for it. "The continuous act of perceiving involves the coperceiving of the self. At least, that is one way to put it. The very term perception must be redefined to allow for this fact, and the word proprioception must be given a different meaning than it was given by Sherrington" (Gibson [1979] 1986: 240).

According to Gibson, proprioception is a constitutive part of perception in the sense that "exteroception is accompanied by proprioception" (Gibson [1979] 1986: 141). Thus, proprioception is also a part or complement of the awareness we have of what we perceive in the external word (Gibson speaks of "egocentric awareness"); its object is a kind of self-perception or better—in Gibson's terminology—of ego-reception or sensitivity to the self: "In my view, proprioception can be understood as egoreception, as sensitivity to the self, not as one special channel of sensations or as several of them" (Gibson [1979] 1986: 115). As 'sensitivity to the self', proprioception is the result of a perceptual system that provides in various

ways information on the global state of the subject as a living system, as an organism who lives in his/her own skin and who keeps track of the information about his/her internal environment.[6]

4 'Proprioception' as Propriosensitive Information

Gibson's view on what proprioception might be and on the function it could play with respect to perception constitutes the first step in the direction of a possible, even more radical revision of the notion of proprioception put forward by past theories and it provides some new suggestions regarding the relationship between proprioception and exteroception. *Specifically,* '*proprioception*' *and* '*proprioceptive information*' *could be redefined as wide-embracing notions including all forms of experience people have of their bodily states*. According to this view, '*proprioception*' *would denote any kind of propriosensitive information and would incorporate* kinesthetic*, sensorimotor and postural information which we are consciously aware of as well as sensations generated from and related to the general state of the body and its parts and organs.* Since this broad definition of the notion differs from the way in which it has commonly been understood in the field of neuropsychology (where Sherrington's differentiation between interoception and proprioception still apply), when we use it in this work we will put it in inverted commas. In other cases, we will use the term (also of Gibsonian origin) propriosensitive information.

Even though the literature still lacks a specific characterization of bodily information and the way in which it is represented (Alsmith and de Vignemont 2012), it seems undeniable that we have some 'proprioceptive' awareness, even though—especially when we are focusing on the external world—it is not usually the most salient ingredient of our conscious experience and rather remains in the background. If the direction indicated in Gibson's work is correct, '*proprioceptive*' *awareness accomplishes a fundamental function in carrying out any kind of cognitive operation, including those related to perception*. In fact, this is the hypothesis we will try to support in this chapter along with the idea that 'proprioception' is an essential component of how we represent ourselves to ourselves as well of how we represent any other objects in our experience (Gallagher 2005); or even more radically, the idea that proprioception (propriosensitive information) constitutes the condition of possibility for 'humanlike' cognition.

[6]In this sense, proprioception is a constitutive component of all the systems of our organism, to include the postural system, the system that coordinates orientation and locomotion, the appetitive, performative expressive and semantic systems. Any of these systems involve proprioceptive information (Gibson [1966] 1983: 57). Since in Gibson's terms proproception indicates mainly bodily awareness (see Gibson [1974] 1987, [1975] 1987), each of these systems contribute to forming the internal perspective of the first person that humans experience as a result of the embodiment of their cognitive system.

To explain the implications of this view, take for example the visual representation of a distal object like an apple. This includes elements that are not explicitly known by the subject, but accomplish a fundamental function in the constitution of the percept. First of all, all the perceptions we have are '*relativized*' in the sense that they are experienced as *relative to the perceiving subject*, i.e. they are perceptual *experiences* belonging to the subject who is experiencing them. When I see an apple, I know that this is the apple I am seeing, that the perspective I am seeing it from is *my* perspective and that my perception is influenced by the acts I perform in order to see it (such as e.g. orienting my body in a certain position, focusing on the apple, feeling the tension related to the movement I would need to perform to pick it up, etc.). In this sense we can say that—in a wide Gibsonian sense—we continuously and tacitly use kinetic and kinesthetic information in performing perception (Sheets-Johnstone 2009). Moreover, our perceptions are also '*perspectival*': when I see e.g. an apple, I always see it from a certain perspective and in a certain condition: I co-perceive how far it is from me, what direction I would need to move into reach it and what kind of movement I would need to make to grasp it. And the sensations coming from my bodily position and states are relevant for the way I seek information to determine (my sense of) the perspective from which I see and consider the object (Sheets-Johnstone 2010). Furthermore, this propriosensitive information allows me to locate the origin of visual object (the apple) in the external world, i.e. outside the limits of my body, and to 'orient' and to 'position' it in space according to coordinates that are relative to myself as the observer. In this sense, propriosensitive information constitutes—or better co-constitutes—the *frame of reference* for what is perceived and represented (Gallagher 2009). Moreover, perception also depends on *the state* of the perceiving subject: the way in which I experience my bodily states during the perceptual act contribute to determine what I see. If I am e.g. hungry when I experience the apple, it will capture my interest and attention in a more immediate way and thus I will perceive some of its characteristics (related e.g. to its spatial location like proximity vs. distance) in a more immediate and definite way (Sheets-Johnstone 2010). This applies to both actual perceptions and imaginary perceptual acts.

This integration of propriosensitive and exteroceptive information does not occur only for vision. Also in the case of something we perceive through another sense, e.g. through the acoustic, the olfactory, the gustatory or the haptic system, we are aware that *we* are the subjects of that perception (that it is us who are perceiving the stimuli), that the origin of the stimulation is located and oriented in a specific position outside our body; and we perceive the stimulus in a way that it is shaped by our bodily states. Thus, 'proprioception' *enriches* the representations we form of the external world with additional information: this does not only make them much more specific and detailed, but it also connects them univocally to the perceiving subject (determining e.g. their ownership and perspective). Interpreted in this way, 'proprioception' is always involved in perception and the reception of information from the external world can no longer be considered a purely passive or even a neutral process. Since propriosensitive information is continuously produced by the body and it permeates any other kind of information processing, the representations

that people form of the external world are never neutral: because they include information about the perceiving subject, they are always 'perspectival'—the perceiving subject is in a way always co-represented with them.

These considerations allow us to go back to the notion of 'proprioception' (and that of propriosensitive information, which we use as a synonym) and to further specify it in a way that is relevant for the following part of this work. We use 'proprioception' to describe the information produced by the perceptual system (meant in Gibson's sense) when this is primarily directed towards the internal environment of the observer. This 'internal environment' should not be understood in some substantialistic sense, but rather *in terms of the changes occurring within the body and their effects on what the body can catch and perceive*. Following Gibson, like every kind of information produced by the perceptual system, these changes will also be *consciously accessible by the perceiver, at least to a certain extent and under certain conditions*. In fact, 'proprioceptive' (propriosensitive) information on the processes occurring in the body have a recessive nature with respect to the other kind of representations people have and use for thinking, including exteroceptive representations, in the sense that it remains mainly in the background of our experience (O'Shaugnessy 1995) and it constitutes something like a psychical *basso continuo* which is always present and available to the cognitive system even though it is rarely in the focus of our attention.

The reason why propriosensitive information remains in the background of our awareness is that our attention is usually directed outwards. However, 'proprioception' cannot be considered as a source of information which is extraneous with respect to perception. If 'proprioception' were separated from perception, we would have two sources of information that were *contrasting* and *competing* with each other in the constitution of what is perceptually salient for the subject. And this is not the case. As is emphasized e.g. by Brian O'Shaughnessy, bodily awareness—i.e. the availability of propriosensitive information—is essential for the constitution of *perceptual scenes*. Indeed, bodily information is a precondition for any kind of finalized action since this allows us to perform actions and sequences of movements that are congruent with perceptual flow. If the body moved in a dysfunctional manner with respect to perception, we wouldn't be able to gain the information we need to act properly. Moreover, if propriosensitive information were not immediately integrated with perception, we would need to readjust our position and orientation through voluntary and conscious actions and the flow of perception would be continuously interrupted (O'Shaugnessy 1995).

Perception is a form of knowledge related to attention and attention is intrinsically selective. Since usually the perception of what is happening outside our skin is the most relevant to us (at least if everything in the internal environment is working well), our attention most often is directed primarily at exteroceptive information—on what we are perceiving in the external world—than to propriosensitive information. However, even though the 'proprioceptive' component of our experience remains mostly in the background of our awareness, it can become the specific object of attention when we focus on our performance of certain perceptual acts. Also in this instance the availability of propriosensitive information does not

generate any conflict with respect to perception; it makes us rather more aware of our actions and movements and of our involvement in perception. Indeed, if we *reflect* on the representation of the apple we have, we can find traces of our co-representation, e.g. in the perspective of the visual representation we have and in the awareness that it is we who are perceiving the apple. Thus, 'proprioception' accompanies and is complementary to exteroceptive perception in the sense that it constitutes the background of the perceptual act as well as a necessary condition for the success of perception; while the traits (i.e. the perceptual features) of this background information can be identified when we reflect on our perceptual act and go beyond what is more salient. These observations are consistent with Gibson's general view on the function of perception. Living organisms look for information in order to ascertain what objects are in the external environment and to act in it. This is the reason why our attention is mainly oriented outwards to the things that are directly relevant for our actions.

Still, 'proprioception' is not always only a background support for external perception. Sometimes it becomes salient and is not accompanied by any corresponding exteroceptive act as for example when we suddenly experience a sensation of pain or we become aware that we are hungry. In these cases, 'proprioception' shifts to the foreground of our attention and we directly perceive our bodily states. Of course even when 'proprioception' is the specific element that draws our attention, it always remains less determinate than perception. Indeed, unlike exteroception, propriosensitive information does not concern something like distal, (more or less) structured 'objects' but rather some kind of internal stimulus. Since internal stimuli are intrinsically vague, the perception we have of them is necessarily vague too. Still, this vagueness does not imply that this perception we have is false or that it is function is irrelevant or marginal with respect to the identification of the object. In fact, this experience is the necessary condition for a person to identify his/her own bodily states and to classify them in some way: it is necessary to identify e.g. that we are in pain or hungry. The subject who has a bodily experience knows that s/he is perceiving something about his/her body and s/he can extract many relevant data from it.

As a matter of fact, as we will clarify in more detail later (in the next section as well as in Chap. 2, Sects. 3–6), in spite of this vagueness, if we reflect on propriosensitive experience, we can individuate other background elements that at first did not stand out and that support the identification and classification of the state. The example of pain is paradigmatic in this respect: pain is indeed a *multidimensional* experience (Melzack and Wall 1996) that feels to us like a simple and unitary phenomenon, even though it incorporates information coming from different sources which can somehow be differentiated in the phenomenal experience we have. We feel pain has a certain intensity (this signal comes from the so-called nociceptive system); however, at first this pain might feel as vague: we know it is something we experience in the body, but we cannot immediately localize it exactly or identify it as having certain characteristic properties. However, if we pay attention to it, we might be able to be more precise: to locate more precisely the source of the pain (e.g. not only where exactly the pain comes from, but also

whether it is more superficial or more deep) and to relate it to specific sensations like e.g. some impairment in movements, muscle tension or analogous aspects. Furthermore, we can pinpoint some more qualitative features of the pain (for example, whether it is e.g. drilling, burning, pulsating, throbbing, or penetrating). The same applies for other bodily states such as e.g. hunger: hunger cannot only be identified as a specific sensation different from others that are located in the same area—the stomach—but it can also be further specified by its precise features, e.g. it can be identified as more or less urgent or directed towards something specific, etc. The fact that we can distinguish among various characteristics of our internal states supports the idea that 'proprioception' is not fully indeterminate and that it is instead a form of perception, in the sense that propriosensitive experience as a whole provides us with actual knowledge about the internal 'environment' of the body. The 'object' of 'proprioception' (its reference) is, as with perception, the stimulus information that caused it; i.e. its original source (in the 'internal' environment): more specifically it is the bodily condition, state or process detected by the perceptual system through its internal monitoring.

The hypothesis that living beings are equipped with a *propriosensitive perceptual system* that makes information available to the cognitive system about the general state of the body and that this system appears to be an essential and determining factor in the successful outcome of any cognitive processing is confirmed by many recent research lines developed in the fields of cognitive psychology and the neurosciences.[7] Neurophysiological research on multisensoriality is one of the most important developments based on Gibson's views and especially his idea of the perceptual *system*. This work suggests that—even though percepts appear to our awareness as simple, unitary and immediate and thus we have the impression that they are produced by a unique channel—they are actually the result of complex synthetic processes at a low level which operate on stimuli coming from different sensory channels. If we consider the case of the apple again, since in the case of this perception visual information is dominant, we have the impression that the representation of the apple consists of one kind of information only derived from the visual receptors. Research on multisensoriality shows however that this view is wrong and that the perceptual activity cannot be traced back to the processing of one kind of sensory signal only (Ghazanfar and Schroeder 2006; Calvert et al. 2004).

Even though studies on multisensoriality have mainly focused on the analysis of the functioning of what we called exteroceptive perception and are mostly not interested in describing conscious experience, and they frame their achievements merely in terms of what information contributes to generating a perception, they are of great interest for the perspective we are trying to develop here at least for two

[7]The hypothesis that the information provided by the various systems that collect information on the internal states of the body (mainly *proprioception* meant in the narrow sense as information on body position and body movements; *interoception* and *nociception*) is de facto integrated and that it is therefore appropriate to consider it unitarily has been put forward e.g. by Feinberg (2009) and by Craig (2015). On this see below Sect. 5.

main reasons. On the one hand, they confirm the relevance of the notion of the perceptual system also for the field of neuroscience. On the other hand, they also open further lines of investigation on the forms of aware experience that humans have of their body. This primarily concerns the explicit and the tacit/implicit *images* we have of our body—which are called the *body image* and *body scheme* respectively (Gallagher 1986, 1995; de Vignemont 2009); the control that we have over our movements and the capacity to *orient ourselves in space* (Berthoz [1997] 2000; Berthoz and Petit [2006] 2008); the sense of *ownership* we have towards ourselves, i.e. towards the living body we are and towards events occurring within the body itself and its parts (Tsakiris et al. 2007; de Vignemont 2013).

Theories on multisensoriality make an important contribution to understanding what role these kinds of representations play in terms of our capacity to conceptualize our identity (our sense of self). And they also offer at least indirect support for the idea that living beings do have a propriosensitive perceptual system understood as a global collector of information on the states of the body and its parts. They also offer indirect confirmation that this information continuously penetrates cognitive operations leaving traces of its presence at different levels. Still, this presence is not always immediately available, even though it guides cognitive processing since it is intimately related to the development of a sense of self. In Gibson's view, the sense of self also plays a fundamental function in both our perceptual and cognitive processing. If this is the case, then we should conclude that the information provided by 'proprioception' is fundamental for all our mental acts: for the constitution of the perspective from which we perceive the objects in the world; for the constitution of the space we act in, for the way in which we represent ourselves in the world, for the way in which we perceive ourselves as entities in the world; for the way in which we perceive what happens outside us; for the way in which we perceive what happens inside us, etc. In this work we will follow this line of research and we will use the term 'proprioception' or, equivalently, 'propriosensitive information' in the sense described here to include all kinds of bodily information that is available to us and that our cognitive system may use to carry out its operations and to process information.

5 Bodily Mapping and Propriosensitive Monitoring

The idea that living beings continuously map their internal states and use their bodily experience as an informational source to build representations of their internal states, of themselves and of the external world is also supported by work in the field of neuropsychology. At least two particularly prominently positions deserve mention here, those of Antonio Damasio and A.D. (Bud) Craig.

Among Antonio Damasio's starting points we find the idea that the mind is a "spectacular consequence of the brain's incessant and dynamic mapping […]. The mapped patterns constitute what we, conscious creatures, have come to know as sights, sounds, touches, smells, tastes, pains, pleasures, and the like" (Damasio

2010: 307). External as well as internal information is acquired by the same means, or more specifically through the same vehicle—the body—and it is integrated to form the unitary perception of the world we experience.

> Because of this curious arrangement the representation of the world external to the body can come into the brain only via the body itself, namely via its surface. The body and the surrounding environment interact with each other, and the changes caused in the body by that interaction are mapped in the brain. It is certainly true that the mind learns of the outside world via the brain, but it is equally true that the brain can be informed only via the body. The second special consequence of the brain's body aboutness is no less notable: by mapping its body in an integrated manner, the brain manages to create the critical component of what will become the self (Damasio 2010: 97–98).

In Damasio's view, exteroception is nothing but an internal perception of our body being affected by external stimuli and in this sense exteroception is in itself a form of bodily information. Of course, usually when we perceive something we are not so much aware of our body being affected by this something, but rather aware of the stimuli in the external environment that caused this effect. This is the result of how perceptual processes work: they tend to hide the body itself as much as possible, so that we can focus on the external objects of our perception. Still, this effect is only brought about by a shift of attentional focus and it is due to the fact that mostly we need to direct our attention to the outside would. Even so, the body remains always in the background of our awareness: not only does bodily information continue to impinge on us, even though in a silent manner, but a small change of the attentional shift from the outside to the inside suffices to bring the body back to the foreground and to make us aware of our bodily feelings.

> In the beginning, there was no touching, or seeing, or hearing, or moving along by itself. There was, rather, a feeling of the body as it touched, or saw, or heard, or moved. To a considerable extent, this arrangement would have been maintained. It is appropriate to describe our visual perception as a "feeling of the body as we see," and we certainly "feel" we are seeing with our eyes rather than with our forehead. […]. It is true that the attention allocated to the visual processing itself does tend to make us partly unaware of the body. However, if pain, discomfort, or emotion set in, attention can be focused instantly on body representations, and the body feeling moves out of the background and into center stage. We are actually far more aware of the overall state of the body than we usually admit, but it is apparent that as vision, hearing, and touch evolved, the attention usually allocated to their component of overall perception increased accordingly; thus the perception of the body proper more often than not was left precisely where it did, and does, the best job: in the background (Damasio 1994: 232–233).

In Damasio's view, all the changes occurring within our body are continuously mapped by the brain as they evolve. The way in which the brain 'informs us' of the outcomes of this mapping is through awareness, viz. through the *feelings* we experience. "That process of continuous monitoring, that experience of what your body is doing while thoughts about specific contents roll by, is the essence of what I call a feeling" (Damasio 1994: 145). These feelings are at the basis of any perception: they are the precondition for and the vehicle of any kind of perception, external as well as internal.

As Damasio puts it: "The human brain is a born cartographer, and the cartography began with the mapping of the body inside which the brain sits" (Damasio 2010: 68). These maps are not only registrations of changes actually occurring in the body due to external and external stimuli, they can also be constructed through the recall of past memories and they recreate past feelings even in the absence of the actual stimuli. These maps keep track of all that happens inside the body as well as in the outside word. They are not mere copies of what we experience, that passively record some data, but the active, integrated product of all the kinds of experiences we have. We become aware of these maps in the form of perceptual images and once they are formed can also be re-evoked to the mind (reconstructed) as recalled images. This reconstruction can also be used to form images of possible future states and to make plans about them (see e.g. Damasio 1994: 94ff). These perceptual images allow us to be aware of what happens outside and inside us; they are, among other things, the precondition for using verbal symbols.

> The nonverbal kinds of images are those that help you display mentally the concepts that correspond to words. The feelings that make up the background of each mental instant and that largely signify aspects of the body state are images as well. Perception, in whatever sensory modality, is the result of the brain's cartographic skill (Damasio 2010: p. 75).

Damasio's suggestion that the brain is a cartographer which maps all the bodily changes occurring inside the body exhibits relevant analogies with the Gibsonian idea of a global perceptual system which records, processes and integrates all the kinds of sensations that we experience related to both our external and our internal environment. Moreover, being also directed inwards, this mapping also explains why we are aware of our bodily states. In this sense, it works as a 'proprioceptive' (i.e. propriosensitive) system that makes us aware of what is happening inside our body. Even though internal ('proprioceptive') information remains mostly in the background of our experience, on certain occasions—when the bodily changes are remarkable and relevant for the organism's survival—it becomes salient; when this happens, we perceive bodily changes directly and through them gain information about our somatic states (e.g. we are in pain, we are hungry etc.) and our emotions.

According to Damasio, any kind of feeling related to something that happens inside our body is due to changes in body states. These cause automatic physiological reactions and corresponding mental experiences which in turn trigger corrective physiological responses. Their role is to assure "the maintenance of the body's physiology within an optimal homeostatic range" (Damasio and Carvalho 2013: 143). They have a regulatory function: they provide information on the state of the body in order to support appropriate responses that assist with life management. These feelings result from a combination of sensations that depend on the changes that happen inside the body. As Damasio exemplifies:

> To grasp what I have in mind, I ask the reader to imagine a state of pleasure (or anguish) and try to itemize its components by making a brief inventory of the varied parts of the body that are changed in the process: endocrine, cardiac, circulatory, respiratory, intestinal, epidermic, muscular. Now consider that the feeling you will experience is the integrated perception of all such changes as they occur in the landscape of the body. As an exercise,

> you can actually try to compose the feeling and assign values of intensity to each component. For each instance that you imagine, you will obtain a different quality (Damasio 2010: 106).

According to Damasio's description, internal states are not a-specific, they are not just undetermined sensations or states of arousal, but quite specific feelings that can be characterized and distinguished by virtue of their characteristic features. Every bodily change on the "landscape of the body" and the intensity of this change gives rise to a specific quality which we experience and identify as such. It is on the basis of this qualitative experience that we get acquainted with what is happening exactly inside us.

Bodily feelings are the vehicle through which we perceive anything that occurs in our body, not only feelings of somatic states (like pain, hunger, thirst, etc.) but also emotions (e.g. happiness, sadness, anger, fear, disgust etc.). In Damasio's view emotions (meant in the sense of salient emotional episodes) are particular kinds of bodily feelings that we can perceive and that depend on changes of bodily states. They are triggered by something (a situation or a thought) that evokes a bodily response that is salient enough to catch our attention and shift it from the outside world to ourselves (Damasio 2010: 119ff).

> All emotions use the body as their theater (internal milieu, visceral, vestibular and musculoskeletal systems), but emotions also affect the mode of operation of numerous brain circuits: the variety of the emotional responses is responsible for profound changes in both the body landscape and the brain landscape. The collection of these changes constitutes the substrate for the neural patterns which eventually become feelings of emotion" (Damasio 2000: 51).

In Damasio's perspective, those particular feelings which we call 'emotions' accomplish the function of informing us in an immediate and pre-conceptual manner about the relationship between ourselves as living organisms that need to stay alive and to preserve vital functions and the objects and events that constitute our external environment. Our knowledge of the emotion we are experiencing—and thus also of whether something we are experiencing is positive or potentially dangerous for us and of how we should react—goes through the body: it is the bodily feelings and the conscious experience we have of them that tells us (makes us aware) what emotion we are experiencing (we will go back to the issue of whether bodily feelings can uniquely identify emotions in Chap. 5).

Like bodily feelings, emotional states also affect external perception: depending on how we feel (e.g. happy, sad, angry, fearful, disgusted etc.), the outside world is perceived differently, i.e. the perception of things and the thought processes related to them are modified. No matter how hard we try, we cannot ignore these feelings and separate our perceptions and thinking processes from them. Moreover, external perception is influenced by other bodily feelings which are analogous to emotions even though they are not salient, short emotional episodes that drive the attention to the inner states of the individual. Indeed, according to Damasio there are bodily feelings that tend to remain in the background of our experience—and for this reason should be called background feelings—which accompany any kind of

perception and 'paint it' (provide it) with a specific hedonic tone. They determine how we feel during a certain period of time. As Damasio specifies:

> […] background feelings are neither too positive nor too negative, although they can be perceived as mostly pleasant or unpleasant. In all probability it is these feelings, rather than emotional ones, that we experience most frequently in a lifetime. We are only subtly aware of a background feeling, but aware enough to be able to report instantly on its quality. […] The background feeling is our image of the body landscape when it is not shaken by emotion. The concept of "mood," though related to that of background feeling, does not exactly capture it. When background feelings are persistently of the same type over hours and days, and do not change quietly as thought contents ebb and flow, the collection of background feelings probably contributes to a mood, good, bad, or indifferent (Damasio 1994: 150–151).

Damasio's background feelings are thus feelings like well-being or malaise, calm or tension (Damasio 2000: 50) which are the precondition for having moods.[8]

The common denominator of all bodily feelings—be they feelings corresponding to somatic states, emotions or background feelings—is exactly that they are *feelings*, in the sense that *they are something we consciously experience, which is characterized by a particular quality and which we detect through a form of perception directed inwards*. Different bodily states correspond to different feelings (they feel differently) and this is the reason why we can differentiate among them and identify them. For Damasio, we know that we are in a particular state because we have conscious access to the bodily information corresponding to that state. In his view, our 'introspective capacities', meant in the sense of the capacities we have to report what we feel inside us, are related to our ability to verbally convey the conscious sensations produced by our bodily states.

Further support for Damasio's neuropsychological hypothesis on the existence of an internal (brain) mapping that accomplishes the function of what we have called propriosensitive system is also provided by the recent work of A.D. Craig. Craig provides neuroanatomical evidence that we have a system for the representation of the self which consists in a continuous mapping of our bodily states in which all the signals coming from the different areas of the body and traditionally characterized as proprioception (sense of position and movement), interoception ("the sense of the physiological condition of the body" (Craig 2003)—e.g. hunger, thirst, visceral functions, cardiorespiratory control, temperature, itch, sensual touch, muscular and visceral sensations, vasomotor activity etc.) and nociception (perception of pain) *are merged*. The integration of all these signals constitutes the

[8]Damasio also distinguished between background feelings and background emotions (Damasio 2000, Chap. 2). Strictly speaking, the real analogy should be between existential feelings and background emotions. Background emotions are a subset of background feelings: while background feelings describe generically all kinds of bodily feelings (including also those directed towards the body for example being satiated or experiencing an almost imperceptible pain in the foot while sitting etc.), background emotions only denote those background feelings that determine our relationship with the external world and others. However, the really relevant element of this analogy is that both authors consider bodily feelings as the common background for all kinds of internal states: emotional as well as physical.

deeper and original core on which the conscious awareness of all our internal states, be they emotional or physical (e.g. hunger, thirst, itch, burning sensation, but also anxiety, relaxation and the like, etc.), is grounded.

> The key stage of integration at the core of this model is a coherent representation of all feelings at one moment, which I referred to as a 'global emotional moment'. This construct can also be called 'the sentient self' (Craig 2010: 563).

Craig is persuaded that this global awareness of our bodily condition is realized by a specific brain area—i.e. the insula—which provides sensory representations of the affective feelings from the body, integrates these representations with other data coming from various other sources (Craig 2002, 2008) and instantiates all feelings the subjects perceives which are the basis of the *sentient self* or *material me* (Craig 2009, 2010, 2015). In particular, consistently with Damasio's view—which he mentions explicitly—Craig suggests that "the anterior insular cortex […] contains interoceptive representations that substantialize (that is, provide the basis for) all subjective feelings from the body and perhaps emotional awareness […]." (Craig 2009: 59) By virtue of the work carried out by this part of the brain, we gain conscious access to our 'interior life' meant as the integrated signals coming from all parts of our body. This gives rise to a kind of 'interoceptive awareness' which describes the global representation of the internal perception we have of our body. Since Craig considers the insula to be the locus where all of this information is integrated, in his view the traditional separation between different mechanisms such as interoception, nociception or proprioception no longer makes sense. Thus, we can speak in general of internal perception.

In fact, even though Craig lists interception first, in Gibsonian fashion it seems more appropriate to speak generally of '*proprioception*' and of a '*proprioceptive*' *or propriosensitive system*. The way we use this term in this work diverges from the usual, technical definition of proprioception which only denotes information provided by the muscular and skeletal systems. The way we understand 'proprioception' is more similar to the notion of interoception as described by Craig. However, by using the old Gibsonian term 'proprioception' we intend to recall Gibson's idea of a general and integrated system of perception that is both propriosensitive and exterosensitive. Furthermore, the word 'proprioception' suggests that we can consider internal perception as something unitary and undifferentiated: if we are interested in understanding how bodily signals are consciously perceived, we do not need to distinguish between the various internal channels or sources that might carry different bodily signals, because these gain access to consciousness as an integrated whole.

Even though Damasio and Craig's views exhibit relevant differences with respect to Gibson (and with respect to each other), globally they can be interpreted as an updated extension of Gibson's original intuition about the nature, function and organization of perception as the outcome of integrated perceptual systems that are continuously active and that are directed toward both the external and the internal world of the subject. Furthermore, they suggest that humans can feel their body from the inside and that these feelings are the permanent background of our

experience as living creatures: they permeate and influence all kinds of perceptions that we can have. Disregarding the specificities of their views, the position that emerges from their analyses suggests that living organisms are equipped with an internal perceptual system that is propriosensitive and detects, integrates and makes available to consciousness the information produced by bodily changes. This underpins the idea that humans (as opposed e.g. to computers) are equipped with a propriosensitive ('proprioceptive') system that produces sensory information about their bodily states which they are consciously aware of, even though it is recessive and vaguer than exteroception. Indeed, as we discussed above, bodily sensations remain mostly in the background of our awareness. And yet, if we draw our attention to them, many characteristics can be brought more sharply into focus: the complex of sensations produced by these modifications become more salient and this allows us to conceptualize ourselves as beings equipped with an 'internal world'.

The complex of the sensations generated by bodily changes is represented in our mind at a low level of awareness and it remains in the background of our experience. This propriosensitive system produces representations of (information on) the internal environment of the subject by synthesizing the signals coming from the various bodily parts in a unitary and stable manner and providing a constant, dynamical mapping of internal states and their changes. These representations are always present to our cognitive system, even though they are usually in the background and thus beyond the usual focus of selective attention. For this reason, the representations we have of our internal states are *vague*. For a long time, this vagueness has been interpreted in terms of an intrinsic ambiguity because of which it was impossible to explain in a conceptually stable manner how we get the knowledge we have of our internal states. Well known examples of this view are the criticisms of introspection made by both the psychological and the philosophical traditions (see, a.o., Boring 1953; Nisbett and Wilson 1977; Lyons 1986; Schwizgebel 2012). However, even though we experience the changes occurring in our body in a rather indefinite manner, this perception is neither a-specific nor cognitively impenetrable. As a matter of fact, when these states become particularly salient and/or when we pay specific attention to them we become explicitly aware of their content and we can reflect on them. This reflection allows us to trace back the origin (the localization) as well as the specific quality of these internal representations.

In fact, a similar phenomenon happens in the structure of visual perception with regard to the opposition between figure and ground. When we see, we see primarily (we focus primarily on) the figure—i.e. (on) what is in the foreground. Still, this does not mean that the information in the background is not present. On the contrary, the background information represents the condition for constituting the distal percepts in a sharp and clear manner. On the basis of this analogy, 'proprioception' can be seen as a system that continuously provides information on the states of activation of the body at a low level of awareness, giving us the possibility of having at any given time a background knowledge of our situation as living organisms. The propriosensitive system offers a continuous mapping of the changes

occurring in the body and the sensations detected through this are perceived as *somatic events*. Even though these are perceived only in a vague manner, they still have a *content* and more specifically a *reference* which consists in the bodily states or bodily changes that have been mapped by the system. This system produces representations of the internal environment of the body that keep track of their origin. The conscious information we have on our bodily signals inform us which parts of the body have changed their levels of activity and how. Thus, we can use this information to identify the bodily changes we are experiencing. Moreover, since we have conscious access to this kind of information, it can be used for higher cognitive processing that also involves e.g. conceptualization and language: we can convey tacit information using explicit, verbal forms of knowledge about our internal states. Finally, this kind of information influences and structures every other kind of experience we have and its content can be reconstructed starting from the contribution it makes to other kinds of perceptions.

The relevance of these last aspects becomes clear when we consider the perspective of the anti-mentalistic approach stemming from logical empiricism, behaviorism and functionalism (see Chap. 1), which suggests that internal states cannot be grasped directly, and we need to develop a third-person approach to determine what they are. The actual nature of internal states can be understood only if we develop a way to avoid subjectivism and describe them on the basis of intersubjectively observable—i.e. external—elements. Because qualitative experience and more generally internal sensations have a univocally subjective nature, the anti-mentalistic tradition has for a long time imposed the view that internal and qualitative states should not be identified directly on the basis of their intrinsic properties through something like internal ostension. They should be rather identified in a relational manner using the set of observable events (i.e. situations and behaviors) occurring outside the body in correspondence with the internal states. An emotion like e.g. 'love' should not be identified or described on the basis of how it feels to be in love, but rather in terms of the observable condition in the external world that 'goes with' love.

The idea of a 'proprioceptive' system (i.e. of a propriosensitive perceptual system) we tried to support in this section challenges this approach and suggests that human perception and cognition cannot be addressed starting exclusively from a third person perspective. On the contrary, the general perspective that emerges from the views we considered above suggests that the internal, qualitatively characterized information produced by the body needs to be taken into account in order to provide an adequate description of how the mind works because it performs a critical function both in terms of how we experience the world and how we think.

If the hypothesis about the existence of a propriosensitive system of the kind we outlined is correct then we can conclude that the amount of information (at least tacitly) available to our cognitive system to individuate, recognize and classify internal states is much larger than has been traditionally admitted. Further, that information we gain about our bodily states is central for developing our knowledge of both our internal as well as external world. The idea of introspection thus gains new meaning as a capacity to focus on the internal information which is consciously

available to us and form some conceptualization of it in spite of its vagueness. Finally, this hypothesis constitutes a first step in overcoming the intrinsic abstractness and formalness that characterize classical cognitive theories. It emphasizes the fact that knowledge is produced by living organisms and that the functions of biological organisms are of primary relevance in understanding how information and knowledge are acquired and processed by the cognitive system.

6 Bodily Feelings and Emotional Experience

In the previous sections of this chapter we pointed out that 'proprioception' contributes to perception and provides us with information on the internal states of the body (i.e. it reveals what is happening in the body at a certain moment and where this is happening). On the basis of Damasio and Craig's views, we considered whether (and why) emotions may be nothing but bodily feelings and that the awareness we have of our emotions derives from the bodily feelings we experience when we have an emotion. From this perspective, emotions reveal something about our relationship with what is happening outside us: they tell us whether what is happening in the external environment at a certain moment is positively or negatively related to us and they also 'color' our perception which is influenced by the way we 'feel'. In fact, emotional experience is of crucial relevance for a discussion of our hypothesis of an integrated propriosensitive perceptual system for at least two reasons that are also related to each other. On the one hand, it offers us some more elements for clarifying more precisely what propriosensitive information is: i.e. what kind of information the propriosensitive system provides, how specific it is and what it is used for. On the other hand, a discussion of emotions as a kind of internal experience can help us address the issue of whether and how propriosensitive information plays a role with respect to cognition and what this role exactly consists in.

The authors that offer a particularly relevant contribution as we start to discuss these points and to introduce the specific analysis of emotional experience which will be carried out in Chap. 5 are Peter Goldie and Matthew Ratcliffe. In spite of the differences between their positions, they share the idea that the knowledge we have of our emotions and more generally of our internal states relies, at least in part, on internal information produced by the body which is available to our awareness. Their views offer relevant clues in support of the idea that humans are equipped with a propriosensitive system which provides us with essential information to carry out any cognitive process as well as suitable insights on how we can identify these internal states on the basis of the information provided by the propriosensitive system.

Goldie's view belongs to a line of research called "perceptual account of bodily feelings" (Goldie 2002: 236) which opposes the traditional, philosophical and psychological view that bodily feelings (sensations) are radically different from perceptions in the sense that they cannot give rise to any knowledge. According to

this traditional view, apart from perception, sensations do not produce stable and coherent knowledge, e.g. representations referring to something specific, that can be re-identified on different occasions. Sensations are epistemically unreliable because they are not precise enough to support the constitution of representations with stable properties. In opposition to this perspective, the perceptual accounts of bodily feelings argue that bodily sensations are specific enough to allow us to identify events that occur in us (Armstrong 1968; Crane 1998). These events can be identified quite precisely through temporal and spatial coordinates: we know when and approximately where in the body they occur (Martin 1995). Goldie applies this view to emotions as a particular kind of bodily sensations or feeling we experience and suggests that it is the feelings involved in an emotion which allow us to know what emotion we are experiencing.

Consider the following two examples given by Goldie: the experience of an agonizing pain in the elbow on the one hand and that of the fear of a lion on the other. In the case of the pain, we know that we are experiencing it because we have specific bodily feelings that inform us about the pain, its intensity and its localization at the elbow. Thus, these feelings are everything we need to know we are in pain. The case of the fear of a lion is similar, but not identical. Here our knowledge that we fear the lion derives also from the sensation of fear we experience; however, the case for fear differs from that of pain, in that our knowledge of fear is not exhausted by the sensation we experience. In Goldie's view, there is more to know about fear. When we experience an emotion like fear we feel in a certain way but we also know the reason for this feeling, i.e. we know *toward* what this feeling is directed: we know that we fear *the lion*.

Somatic states like pain (or like hunger, itch, spasm etc.) are not directed toward anything other than themselves: their only object is the body condition in a certain moment, e.g. the agonizing pain in the elbow. Unlike somatic states, emotions are more complex bodily states which involve both a bodily feeling and an external object towards which the emotion is directed. For this reason, Goldie maintains that "emotions involve two kinds of feelings" which he calls "bodily feelings" and "feelings towards" (Goldie 2002: 235). The notion of *bodily feeling* describes the specifically perceptual—i.e. the bodily—component of the emotions. In the case for example of fear, this could consist, among other things, of hair rising on the back of our neck (Goldie 2002: 235–236). However, in Goldie's view bodily feelings alone are too vague to determine what emotion we are experiencing. They become recognizable as one specific emotion only when they are accompanied by—or more specifically blended with—an external state, object, person or event *toward* which they are directed. "Bodily feelings alone cannot reveal to you what your emotion is about; as we have seen, the most they can reveal is that you are feeling an emotion about something or other, which has a certain determinable property. Feelings towards, on the other hand, are directed towards the object of one's emotion as such —for example, feeling fear towards the lion" (Goldie 2002: 241). Thus, the notion of *feeling toward* describes our awareness of the object toward which an emotion is directed. In this view, emotions are somatic states with an additional ingredient

consisting of feelings which inform us that the somatic state is directed toward something specific in the external world.

In his examination of emotional experience, Goldie maintains that both kinds of feelings that constitute emotions are *intentional* (in Brentano's sense), i.e. they have a specific content. This is hardly surprising if we consider the aspect of emotions characterized by our feelings *towards* an external object: we fear a *lion*; we love *someone*; we are angry about *something,* etc. These kinds of feelings are clearly intentional because they are about the object they are directed toward. The most remarkable part of his view lies in the hypothesis that the aspect of emotions consisting in bodily feelings also has a content.

> A bodily feeling or sensation, the feeling from the inside of the condition of one's body, is intentional in the sense that the feeling is directed towards an object, one's body, as being a certain way or as undergoing certain changes. I will call this, as others have done, the perceptual account of bodily feelings. When you feel an agonising pain in your elbow, the object of the sensation is your elbow which feels a certain way: agonisingly painful. Similarly, when you feel the prickly sensation of the hairs going up on the back of your neck, the object of the feeling is the hairs on the back of your neck which feel a certain way: prickly, as if they were rising. When intentionality is thus understood, in terms of directedness towards an object rather than in terms of "aboutness", bodily feelings are unproblematically intentional, being directed towards a part of one's body in a certain location (Goldie 2002: 236).

Thus, bodily feelings have a content in the sense that they are *directed towards a part of one's body*, i.e. that *they indicate the location in the body certain sensations come from*. This means that they offer a mapping of the internal condition of the body (we know that the pain is in our elbow, that the hairs on the back of our neck are going up etc.). And in Goldie's view these sensations are one of the two kinds of information we use to identify the state we are experiencing. Even though Goldie remains in the line of the anti-mentalistic tradition in considering the external element (the feeling towards) as the most important for determining emotions, he suggests that living beings are able to perceive our "bodily changes from the inside" and that this is the "epistemic route" to the knowledge that we are experiencing an emotional episode (Goldie 2002: 237).

This internal perception captures our internal sensations and provides us with conscious information about our bodily conditions at a given time: "Bodily feeling involves consciousness – from the inside, so to speak – of the condition of your body, or of changes to it, such as muscular reactions (including changes in facial expression), hormonal changes, and changes to the autonomic nervous system; I will call these bodily changes" (Goldie 2000: 51). These internal perceptions are not as precise as the perceptions of external things; for this reason, the knowledge we can have of them is also less clear and precise than in external perception: 'proprioceptive' representations do not have the 'sharp profile' and the specific form of 'self-subsistence' that characterizes representations of objects in the external world. Emotional episodes are perceived as a-specific, but also as inseparable from ourselves. The first characteristics indicate that—even though emotional feelings are not wholly ambiguous—we cannot represent what is happening inside us in a clear

and distinct manner. The second characterization indicates that emotional states cannot be represented as something other than ourselves; this way of experiencing emotions is due to their bodily origin, in the sense that we perceive emotions first of all as related to the body, i.e. as being bodily states, and the body is itself experienced as our own body, i.e. as inseparable from us.

Goldie's idea that bodily feelings are characterized by a specific *directness towards a part of one's body* suggests that Goldie sees a relationship between the aware perception of the bodily feeling and attention. As the word itself suggests, *directedness* is related to the attentional focus, because it indicates the fact that we can concentrate on specific bodily signals and this make us aware of the sensations we are experiencing in those specific bodily parts. Directedness can therefore be considered as a particular property of *any kind of* '*proprioceptive*' *state since* '*proprioceptive*' *feelings are always recessive and they remain mostly in the background of our conscious awareness: these become central in our perception or even an object of explicit knowledge only when they capture our attention and when they become the object of reflective consciousness* (Goldie 2000: 62ff). This idea that living beings permanently experience sensations related to the internal condition of their body, but that these sensations come to the foreground of their awareness and become the object of some explicit representation (knowledge) only when their attention is directed toward them could be considered as the general way in which the propriosensitive perceptual system works.

This nature and the effects of this permanent background awareness of our bodily condition can be further investigated and specified using e.g. Matthew Ratcliffe's description and explanation of the so called *existential feelings* which also offer an additional argument in support of the idea that human beings are equipped with a propriosensitive perceptual system that detects any kind of internal information and that makes it available for cognitive processing. Ratcliffe points out that the classical discussion on emotions neglected a number of emotional phenomena which are not included in the "standard list of 'emotions'" but make nevertheless "a considerable contribution to the structure of experience" (Ratcliffe 2005: 46–47).

The phenomena Ratcliffe is interested in resemble, at least vaguely, Damasio's background feelings and are feelings related to our experience with the world: "[…] the feeling body […] is a framework through which world-experience is structured. Even when one is not explicitly aware of the body, it still functions as a structure – giving background to all experience. For example, one can have a sense of 'up', 'down', 'left' and 'right' without being explicitly aware of one's bodily position" (Ratcliffe 2005: 52). Among the feelings that Ratcliffe focusses on there is the "sense of belonging to the world" (Ratcliffe 2012), "sense of reality" (Ratcliffe 2008), "sense of familiarity" (Ratcliffe 2009a) and other more complex feelings concerning our relationship with the world and with other people:

> People sometimes talk of feeling alive, dead, distant, detached, dislodged, estranged, isolated, otherworldly, indifferent to everything, overwhelmed, suffocated, cut off, lost, disconnected, out of sorts, not oneself, out of touch with things, out of it, not quite with it, separate, in harmony with things, at peace with things or part of things. There are references

> to feelings of unreality, heightened existence, surreality, familiarity, unfamiliarity, strangeness, isolation, emptiness, belonging, being at home in the world, being at one with things, significance, insignificance, and the list goes on. People also sometimes report that 'things just don't feel right', 'I'm not with it today', 'I just feel a bit removed from it all at the moment', 'I feel out of it' or 'it feels strange' (Ratcliffe 2008: 68).

The existence of these kinds of feelings is not only supported by everyone's personal experience, important evidence also comes from specific psychiatric illnesses where existential feelings are *altered* and lead to a change in our relationship with the world and/or with other people (see e.g. Ratcliffe 2008, 2009b; Colombetti and Ratcliffe 2012). When one is e.g. depressed, s/he feels detached from the world, disconnected, isolated and unable to interact with the world and with others, as if s/he was observing the world like an external spectator (see e.g. Ratcliffe 2015: 31–32; Ratcliffe and Stephan 2014). Delusions such as e.g. schizophrenia are accompanied by a "profound shift in the sense of reality" and by "a pervasive disconnection from the world and other people". Patients become unable to anticipate what they are about to experience, so they feel a sense of uncertainty, doubt, tension and anomaly and a disruption or fragmentation of self (see e.g. Ratcliffe 2015: 259–260).

Illnesses like these show in a particularly salient manner how our everyday experience is characterized in the background by specific (bodily) feelings which determine very important aspects our experienced relationship with the world and with others. As long as things go well and we are healthy, we tend to overlook these feelings. Their role and importance becomes clear, however, in cases in which—even though our perception remains per se unaltered—the experiences we have radically change in their phenomenology and are qualitatively colored in an anomalous way that can influence and modify the entire course of our thoughts and behaviors.

This mention of psychiatric illness can also help us differentiate between moods and existential feelings. In fact, existential feelings are deeper than moods: this does not mean that they must necessarily be more enduring, since both moods and existential feelings can also shift from moment to moment (Ratcliffe 2010: 367); the point is rather that existential feelings do not simply concern how we feel in a certain moment, but they "are a background which comprises the very sense of 'being' or 'reality' that attaches to our world experiences." (Ratcliffe 2005: 48; see also Ratcliffe 2008, 2010) While we can separate ourselves from our moods—consider e.g. when we apologize, for example, for being in a bad mood—our existential feelings are inseparable from us because they determine the way we perceive and relate to the world and to others (Ratcliffe 2005: 57). Psychopathological illness in which patients undergo fundamental changes in the way they experience themselves, other people or the world show that our usual sense of reality relies on specific '(existential) feelings', which—if altered—lead to huge disturbances in the normal condition.

Existential feelings are background feelings that shape our experience of the world, our actions and our thoughts. They are *felt*, and this means that "they are bodily states of which we have at least some awareness" (Ratcliffe 2008: 2).

However, the fact that they are a kind of—or maybe they are brought about by—bodily states does not mean that they are just "feelings of the body" or that their object consists in bodily feelings (Ratcliffe 2012: 28). They are rather "background orientations through which experience as a whole is structured" (Ratcliffe 2008: 2). In spite of remaining in the *background* of our experience, they play a primary function with respect to the structuring of any other kind of experience.

> [Existential feelings] are ordinarily part of the background structure of experience, constituting ways of finding oneself in a world that shapes more specific experiences. Nevertheless, they are phenomenologically available, as is evident from the various, usually metaphorical descriptions employed to communicate them. So they are part of the structure of experience, rather than an experientially inaccessible contributor to that structure. However, there may be a thin line between noetic and prenoetic aspects of existential feeling. For example, the role of feeling in constituting our sense of reality, which I will discuss now, is perhaps something that is hidden beneath everyday experience and can only be made phenomenologically explicit through reflection upon highly unusual states of oneself or others (Ratcliffe 2005: 53).

Ratcliffe takes the notions of 'prenoetic' and 'noetic' from Gallagher (2005). Prenoetic means that "it shapes experience without itself being an object of awareness or part of the structure of awareness", while 'noetic' indicates "an awareness of one's body, which might not be at the centre of one's attention but is still accessible through phenomenological reflection" (Ratcliffe 2005: 52). Existential feelings have both noetic and prenoetic aspects and thus they are only partially accessible to consciousness in a direct way; other features of them are accessible only indirectly through an analysis of their contribution to other cognitive phenomena. Thus, existential feelings are *recessive* feelings (in the sense of this notion that we discussed before) that can be accessed at least in part through reflection and that can, in part, be reconstructed starting from the role they play as structuring elements of our experience.

Ratcliffe distinguishes existential feelings from other forms of direct awareness of our bodily states as explicit objects of our attention. If I pay attention e.g. to my heart rate, then I become aware of it, because I bring this state to the foreground of my experience. This is a feeling in the body that I am aware of as a feeling of something happening in my body. The situation is not the same when we consider existential feelings: if I feel hopeless, for example, this feeling is certainly in my body (is certainly brought about by my body), however, it is not a feeling concerning my body, but it is much more a feeling concerning something outside myself, i.e. it is something concerning my relationship with the world and with other people. "There is a distinction between the location of a feeling and what that feeling is *of*. A feeling can be *in* the body but *of* something outside the body. One is not always aware *of* the body, even though that is where the feeling occurs." (Ratcliffe 2005: 46) In this sense, we do not become aware of our sense of being hopeless as a bodily feeling—we do not feel it as something like reduced heart rate, reduced pressure, weakness or anything analogous—but become aware of it as an attitude towards the world.

In this respect, Ratcliffe (2005: 49) goes back to Goldie's notion of directness and modifies it in an important direction. Goldie maintains that there are two kinds of directedness. (i) Some feelings like e.g. an agonizing pain in your elbow are just bodily feelings; they are directed toward the body (the body is their object). (ii) Other feelings like e.g. your fear of a lion are 'feelings toward' because they are directed toward an external object. Even though Goldie often makes clear that these feelings might be two inextricably blended components of the emotional experience, he insists that they need to be kept separated. Regarding this aspect, Ratcliff embraces a more radical position and suggests that bodily feelings and feelings towards are one and the same thing: "[…] bodily feelings just are feelings towards. Some are feelings towards the body or parts of it and others are feelings towards things outside the body" (Ratcliffe 2005: 49). In Ratcliffe's view, this distinction is a mistake because we do not experience emotions (usual emotional episodes as well as existential feelings) as two different things, i.e. as a self-directed feeling in a specific part of our body on the one hand and as a feeling directed to something else in the world on the other. We experience emotions as one unitary phenomenon: they are bodily in the sense that they rely on bodily feelings, however they are not perceived as a feeling in our body, but they become part of the way in which we perceive the world: they "are inextricable from the structure of world experience" (Ratcliffe 2005: 49).

Ratcliffe distinguishes emotional experience from the perception of our own body. He maintains that *the bodily feeling that characterizes any kind of emotion is not the perception of a body state*. Giving special consideration to existential feelings, he tries to show that they are not feelings of our body, but rather bodily feelings that contribute to structuring all our experience, including the experience of the external world. They constitute the condition of possibility for having further experiences in the world (Ratcliffe 2015: 33ff). To explain this aspect, Ratcliffe uses the example of touch: touch differs from vision since we cannot differentiate the experience we have of ourselves and the one we have of the external object, but the first is the condition for the second. The experience of ourselves in touch structures the tactile experience itself, while the location of the tactile feeling on the body "does not determine what it is a feeling of" (Ratcliffe 2005: 50). In the same way, existential feelings are bodily feeling but we do not experience them primarily as sensations in our body, but as ways in which the world appears to us. They are part of our intentionality in the sense that they structure it. These considerations might now be enough to explain all three main theses concerning the nature of bodily feeling (including emotions as well as existential feelings) Ratcliffe argues for:

(1) Bodily feelings are part of the structure of intentionality. They contribute to how one's body and/or aspects of the world are experienced;
(2) There is a distinction between the location of a feeling and what that feeling is of. A feeling can be in the body but of something outside the body. One is not always aware of the body, even though that is where the feeling occurs;
(3) A bodily feeling need not be an object of consciousness. Feelings are often that through which one is conscious of something else (Ratcliffe 2005: 46).

Since bodily feelings are a means through which we gain information, they have content. Even though they have no explicit 'object' of their own, they are not 'invisible' or 'cognitively irrelevant' because they influence, or even determine the way in which we perceive any other thing. The perception we have of our body—our bodily feeling—is a non-neutral vehicle for any other kind of perception, which contributes to structuring the objects we perceive; and we cannot approach perception and perceptual objects without considering the contribution and the 'filtering' performed by bodily feelings. Indeed, they are the condition of possibility for perceiving anything and they characterize the way in which and through which we perceive. Indeed, they influence what we perceive since internal and external information is blended together. Existential feelings are a clear example of how feelings towards things outside the body influence the way we perceive these things: how you feel affects not only how you see things, but also what you pay attention to—i.e. how you select information in the external world. And this 'how you feel' is the global effect of the bodily information which we become aware of in the form of bodily feelings.

In spite of the differences between Goldie and Ratcliffe, taken together their position give us relevant clues as for why and how emotional experience might be considered a form of 'proprioception'. They suggest that emotional experience in all its forms relies on bodily feelings and that it is not radically different from the experience we have of somatic states like pain or hunger but is rather a different point along the same continuum (we will go back to this in detail in Chap. 5). To know what emotions we are experiencing is not radically different than to know that we are hungry: in both cases, we could not acquire this knowledge if we didn't have the bodily feelings corresponding to it. Even though internal perceptions are not as precise as the perceptions of external things, bodily sensations are specific enough to allow us to identify events that occur in us. Like other kinds of bodily feelings, emotional experience can also remain in the background of our attention. Nevertheless, even in this case it plays a primary function with respect to the structuring of any other kind of experience.

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