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Intrinsic Multiperspectivity: On the Architectural Foundations of a Distinctive Mental Capacity

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Abstract: It is a characteristic feature of our mental make-up that the same perceptual input situation can simultaneously elicit conflicting mental perspectives. This ability pervades our perceptual and cognitive domains. Striking examples are the dual character of pictures in picture perception, pretend play, or the ability to employ metaphors and allegories. I will argue that traditional approaches, beyond being inadequate on principle grounds, are theoretically ill-equipped to deal with these achievements. I will then outline a theoretical perspective that has been emerging from a theoretical convergence of perceptual psychology, ethology, linguistics, and developmental research. On the basis of this framework, I will argue that corresponding achievements are brought forth by a specific type of functional architecture whose core features are: (i) a perceptual system that is biologically furnished with a rich system of conceptual forms, (ii) a triggering relation between the sensory input and conceptual forms by which the same sensory input can be exploited by different types or systems of conceptual forms, and (iii) computational principles for handling semantically underspecified conceptual forms. Characteristic features of the proposed theoretical framework will be pointed out using the Heider-Simmel phenomenon as an example

The same situation of sensory stimulation can elicit in us quite different and even conflicting mental perspectives on what it is that we perceive. This capacity to employ different mental perspectives on what the senses offer to us is so blatantly obvious that we simply take it for granted in everyday life. It is an all pervading property of the way we are designed, and we are perpetually and effortless engaged in corresponding mental activities. As it is so pervading, it is, in the context of scientific enquiry, extraordinarily difficult for us to direct our attention to it and to find out on which specific features of our mental make-up it is based. However, once we begin scrutinising it, we will quickly become aware that the human capacity to engender, in a given situation, different mental perspectives is a uniquely powerful feature of our mind whose consequences for our perceptual and cognitive achievements one can hardly overestimate. Most importantly, this capacity provides a pre-eminent pillar for our competence to generate culture.

Although this capacity permeates all of our mental activity and thus remains largely inconspicuous, there are some situations which more easily draw our attention to it. For instance, in theatre or cinema we perceive what happens on the stage or on the screen as segments of events going on in the world while at the same time being aware of actually watching a drama or a movie. With respect to a broad range of aspects, we can employ a mental double bookkeeping, as it were, and simultaneously have different spatial, temporal, emotional and other types of perspectives at our disposal. In the “duplication of space and time that occurs in theatrical representation", Michotte (1960/1991, p. 191f.) noted, "the space of the scene seems to be the space in which the represented events are actually taking, or have taken, place and yet it is also continuous with the space of the theatre itself. Similarly for time also, instants, intervals, and successions for the spectators belong primarily to the events they are watching, but they are left nevertheless in their own present." The ability to perform this mental double book-keeping emerges quite early in our cognitive development. It notably manifests itself in the pretend play of children (Leslie, 1987), for which there is experimental evidence for children as young as 1-2 years old. Theatre and pretend play provide striking phenomena in which the availability of simultaneous mental perspectives almost becomes conspicuous at the surface of our phenomenal experience. They prototypically exemplify what William James has recognised as the hallmark of our mental life, viz. that our "mind is at every stage a theater of simultaneous possibilities" (James, 1890/1983, p. 277). Pretend play and other more conspicuous cases of a mental double book-keeping have prompted the question whether they can be explained by a common type of architectural principles of our mind. At the same time these striking phenomena have often impeded the recognition of the extent to which the capacity for simultaneous mental perspectives pervades all our perceptual achievements. The effects of this capacity are much harder to notice in apparently much more elementary situations. We can, for instance, perceive railroad tracks that recede from the observer toward the horizon both as being parallel and, in another mental perspective, as converging. We can perceive four points that are geometrically arranged as forming a square both as a concrete instance of a square or, in another mental perspective, as being four isolated points. We can perceive a circle that is partly occluded by another circle both as two integral circles lying at different depth levels, where the nearer one occludes part of the farther one, or, in another mental perspective, as two differently shaped objects lying side by side in a plane. We can perceive some location on a white wall at which a reddish spot light is directed as both appearing white, or, in another mental perspective, as appearing reddish. Traditionally, such phenomena have been treated under headings such as 'proximal mode', 'amodal completion', or 'constancy phenomena'. They have usually been assumed to predominantly result from highly special and often modality-specific mechanisms rather than from a common core of more abstract and general principles of our perceptual architecture. It is far from obvious, and, needless to say, an empirical question whether these different classes of phenomena express, to some theoretically interesting extent, a common abstract property of our mental machinery. However, the conjecture that they do seems to me warranted, both on theoretical and empirical grounds. These and a range of other phenomena share, or so I believe, at their core some structural aspects that point to much deeper principles of the conceptual and computational organisation of our perceptual system; more specifically to structural and dynamic aspects of the conceptual forms with which our perceptual system is biologically endowed and which provide the given 'data format' for its internal computations. Before I venture, in section IV of this paper, some corresponding conjectures, I will try, in the next section, to make more precise and exemplify what I mean by 'intrinsic multiperspectivity'. In section III, I outline a general theoretical framework that appears to me promising, theoretically and empirically, for dealing with perception in general, and phenomena of 'intrinsic multiperspectivity' in particular.

Phenomena and perceptual achievements as the ones mentioned before raise theoretical problems that are overwhelmingly complex and deep. Therefore it is hardly surprising that we still lack agreements on even the most basic issues. Opinions are already deeply divided on what can be considered core phenomena that can be assumed to serve as a promising empirical basis for the sharp idealisations on which any successful explanatory account of perception has to be based. As analyses proceed, agreements about how to address the corresponding phenomena in theoretical terms will become even less likely, given the fact that our theoretical understanding of apparently much simpler achievements, such as the constitution of ‘perceptual objects’, is rather thin (actually, this fundamental issue is almost entirely by-passed in prevailing approaches). Nevertheless, phenomena pertaining to simultaneous conflicting mental perspectives in perception cannot be regarded simply as side issues. Any theory of perception that neglects phenomena of multiperspectivity would be of marginal theoretical interest only. It poses, however, a particular challenge for perception theory that the variety of achievements that in our ordinary experience and in our ordinary discourse testify to some form of multiperspectivity can hardly be expected to rest on a single coherent set of principles. Rather such phenomena most likely mirror a variety of different aspects of the functional and computational architecture of our mind and involve complex interactions of various subsystems, such as the perceptual system proper, systems for imagination, higher-order interpretative systems and language. The question then arises whether there are sub-classes of such phenomena that can be assumed, on an appropriate level of idealisation, to result from specific internal properties and design principles of the perceptual system proper, understood as that modular component of our mental architecture on which our perceptual achievements are based.

II. Intrinsic multiperspectivity

Here I am interested in only those aspects of ‘multiperspectivity’ that can be tied to structural and functional properties of a single subsystem, namely the perceptual system proper. Therefore, I will make a tentative attempt to single out, among the huge class of phenomena that in some way or the other can be related to ‘multiperspectivity’, a class of phenomena that appear to me as potential candidates for explanatory accounts in terms of specific design principles of the perceptual system proper. Any such attempt depends, of course, on what is meant by the perceptual system proper. I will turn to a more specific proposal in the next section. For the moment, I will simply presume that explanatory needs require us to postulate some system of conceptual forms by which the semantic units of perception (such as ‘perceptual object’, ‘surface’, ‘food’, ‘enemy’, ‘tool’, ‘causal event’, etc.) are coded. I will refer to this system of conceptual forms (that cannot simply be derived or inferred from sensory codes) as the *Perceptual System.*

The phenomena of ‘multiperspectivity’ mentioned above do not seem to lend themselves naturally to explanations in terms of properties of sensory codes. Rather, any explanation has to be based on more complex architectural and functional properties. Accordingly, if we intend to account for such phenomena by internal properties of a specific system, viz. the *Perceptual System,* we have to ascribe to it an internal structure that is sufficiently rich for such an explanatory purpose. I will postpone the question to what extent such an assumption is justified to the next section. In this section, I will introduce the notion of *'intrinsic multi-perspectivity'* and attempt to single out prototypical kinds of phenomena that exemplify the property of 'intrinsic multiperspectivity'. By '*intrinsic multiperspectivity'* I will refer to a kind of multiperspectivity that primarily results from internal structural and computational features of the *Perceptual System*. Consequently, phenomena witnessing 'intrinsic multi-perspectivity' can be explained by intrinsic properties of the *Perceptual System*, without substantially referring to properties of higher-order interpretative systems, systems by which the phenomenal percept is generated, or to properties of interactions of higher-order systems. 'Intrinsic multiperspectivity' is a theoretical (and thus, needless to say, an abstract and highly idealised) notion rather than a phenomenological one and refers to those internal structural and computational features of the *Perceptual System* by which it can, for a given sensory input, simultaneously provide at its interfaces to higher systems multiple 'interpretations'. These 'interpretations' can be conflicting in the sense that the higher-order cognitive systems, by which meanings are assigned in terms of 'external world' properties, assign mutually incoherent interpretations to them.

The notion of *intrinsic multiperspectivity* presupposes an internal structure that is sufficiently rich to yield the corresponding phenomena. If, as presently prevailing accounts of perception presuppose, the conceptual endowment of the *Perceptual System* were rather thin and were basically exhausted by sensory concepts, the class of phenomena pertaining to intrinsic multiperspectivity would be empty. Rather, all forms of multiperspectivity would be due to, say, inferential and interpretative properties of higher-order systems. If, however, empirical evidence speaks in favour of a rich and powerful conceptual structure of the *Perceptual System*, the property of intrinsic multiperspectivity emerges, as I will argue below, as a natural by-product of the computational relation between sensory codes and conceptual forms.

Before I turn to the theoretical issues involved, I will briefly rehearse two phenomena that I regard as prototypical cases of intrinsic multiperspectivity and that I will use for illustrating the theoretical framework tentatively outlined here. Perceptual psychology abounds with phenomena that are eligible for providing examples of intrinsic multiperspectivity, notably those that are grouped under headings such as figure-ground segmentation, bi-stability, the proximal mode, amodal completion, vagueness, or ambiguity between entire mental 'frames of reference'. Once general properties of such phenomena are explored on a sufficient level of abstraction, it becomes obvious that cognitive science teems with corresponding phenomena, which witness, it seems to me, our cognitive capability to simultaneously handle different layers of perceptual interpretations, as it were, that are triggered by the same input. Here, I will refer for purposes of illustration to the phenomena of the dual nature of picture in picture perception, and to the perception of intentional attributes in the Heider-Simmel demonstration, respectively, because they seem to me particularly suited for making more conspicuous structural properties of our mental architecture that we otherwise find difficult to notice because they are an all pervading property of the way we are designed.

The notion of the *dual character of pictures* basically refers to the phenomenon that pictures can generate an in-depth spatial impression of the scene depicted while at the same time appearing as flat two-dimensional surfaces hanging on a wall. In picture perception, we can simultaneously have the phenomenal impression of two different types of objects, each of which seems to thrive in its own autonomous spatial framework, namely, on the one hand, the picture surface as an object - with corresponding object properties such as orientation or depth - and, on the other hand, of the depicted objects themselves with their idiosyncratic spatial properties and relations. We seem to have two mutually incompatible spatial representations at the same time; at least in the sense that they are available internally and we can, without any effort, switch between them. This aspect is phenomenally so conspicuous and striking that we usually do not pay much attention to it. Though such switches are correlated with depth aspects, they actually pertain to the entire perceptual organisation of the visual field and thus to attributes like shape, or shading and brightness gradients. Gombrich (1982) made the important observation that one has to achieve the proper 'mental attitude' to take full advantage of the capacity to switch back and forth between the reality of the picture as an object and the reality of the depicted objects. Michotte (1948/1991) recognised the challenge that this kind of phenomenon poses for perception theory. Although a wealth of observations pertaining to this kind of phenomenon has accrued in the literature, our theoretical understanding continues to be poor (see Mausfeld, 2003b, for a more detailed account).

The same applies for the second type of phenomena that I will use here as a potential case of intrinsic multiperspectivity. It can best be exemplified by the famous Heider-Simmel demonstration (cf. Scholl & Tremoulet, 2000), in which a small and a large triangle and a small circle move against and around each other and an open rectangle (see Figure 1 for a movie still), and where observers unanimously perceive this event in terms of intentional concepts, such as chasing, looking for, hiding, conferring, being furious or frightened, etc. If, however, the movement of the figures is speeded up or slowed down these intentional impressions deteriorate or vanish entirely.

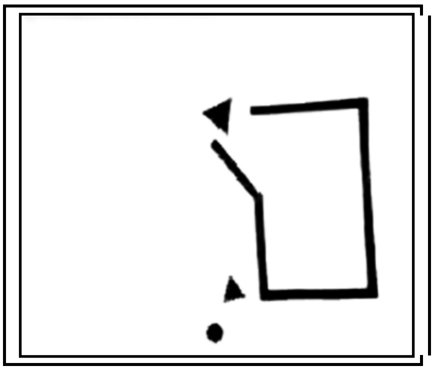

Fig.1: Movie still from the Heider & Simmel (1944) movie

Obviously, the movement patterns of these geometrical objects suffices for eliciting a perceptual ascription of complex internal attributes pertaining to dispositional attributes of perceptual objects of the type *'agent'* or *'mykind*'. Although in this demonstration, we undoubtedly and irresistibly perceive self-propelling objects with intentional attributes, we still are aware that actually we see only geometrical objects moving, again a kind of double book-keeping. As in the case of picture perception, one kind of percept does not vitiate the other, both can exist simultaneously as two layers of perceptual interpretation, as it were. Despite the fact that we ascribe in the Heider-Simmel demonstration anthropomorphic properties to the perceptual objects, it would never occur to us to actually interact with these objects.

As the Heider-Simmel demonstration illustrates, our perceptual systems is highly sensitive to mechanical and intentional contingencies, which can activate perceptual 'interpretations' that go far beyond any given sensory information. By these contingency we segment our world into animate and inanimate objects and, in the case of non-mechanical contingencies or causation at a distance, attribute agency and internal intentions to a perceptual object. Perceptual objects of the type 'animate object' can already by activated by appropriate temporal sequences of 2-D shapes (even pre-linguistic infants attribute intentionality to abstract shapes based solely upon spatio-temporal variables, e.g. Johnson, 2003; Hamlin, Wynn & Bloom, 2007; Luo, Kaufman & Baillargeon, 2009). These perceptual achievements are part of our general capacity for making causal assignments and for embedding all of our experiences into various kinds of internal causal analyses. Due to this capacity we can visually attain aspects of 'perceptual objects' that pertain to their 'hidden' dispositional powers and propensities (which in the case of perceptual objects of the type *'mykind'* pertain to 'mental states'). Empirical observations and theoretical considerations strongly suggest that the capability to mentally interact with others is part of the new-born's biological endowment, which quickly matures to a state where the child can impute mental states to oneself and to others. This biological endowment requires the availability of appropriate conceptual forms (whose nature is still at the boundary of scientific elucidation) that have their proprietary ways of exploiting the sensory input. The Heider-Simmel demonstration illustrates that the conceptual forms involved code properties that go far 'beyond' those physico-geometrical properties that can be coded by sensory codes.

These two examples, the dual nature of pictures in picture perception and the Heider-Simmel phenomenon, appear vastly different from our ordinary perspective. Although one could easily find similarities in terms of, say, certain phenomenal intricacies, or attentional aspects, such similarities do not directly lend themselves to the idea, as ventured below, that both classes of phenomena are brought forth by a specific internal structural and computational property of the *Perceptual System*.

III. Fundamental aspects of the functional architecture and the conceptual forms underlying perception

The notion of *intrinsic multiperspectivity* as employed here is tied to a specific theoretical conception of the functional architecture underlying perceptual achievements. While it is generally agreed that a perceptual system, however conceived, can in an idealised manner be distinguished from other systems of the mind and thus can be made an object of independent enquiry, ideas about how to conceive of this system, in particular assumptions about its conceptual and computational richness, diverge vastly. If it is assumed, as reigning theoretical frameworks in perceptual psychology do, that the conceptual apparatus of the perceptual system is confined to elementary sensory concepts, no issue of *intrinsic multiperspectivity* could arise. On such conceptions, to which I will refer as the *Standard Model of Perception*, the entire explanatory burden with respect to phenomena such as the dual nature of pictures, the Heider-Simmel demonstration, amodal completion, etc. is placed upon higher-order interpretative systems. While this could have been possible in principle, corresponding conceptions are highly inadequate both on empirical and theoretical grounds (for details see Mausfeld, 2002, 2003a, in press).

The *Standard Model of Perception*, in its many guises, is grounded on a distinction between sensations, as the 'raw material' of experience, on the one hand, and perceptions, which are typically conceived of as referring to objects in the external world. According to this model, the process of perception can essentially be described as subsequent stages of 'information' processing by which the sensory input is transformed into the meaningful categories and distinctions, namely the 'perceptions', whose meanings derive from what they refer to in the external world. The *Standard Model* presumes that the biologically given conceptual endowment underlying perception is confined to a rather thin set of sensory concepts from which all other concepts have subsequently to be derived by some inductive or associative machinery. Apart from being unmotivated from the point of evolutionary biology, this presumption, however, does not derive from empirical evidence but rather expresses a deeply entrenched epistemological prejudice, namely the empiricist conception of the mind.

The key conceptual flaw of the *Standard Model* is that it is based on a fatal conflation of the input with the output of the system under scrutiny. It surreptitiously borrows semantic distinctions, such as 'perceptual object', 'surfaces', 'shadows', or 'illumination', tacitly from the output of the perceptual system and uses them for a description of the input (particularly when the *Standard Model* is supplemented by an inverse optics approach of ‚recovery of world structure'). Because of this, the *Standard Model* trivialises what can be regarded as the *Fundamental Problem* of perception theory, viz. the identification of the principles by which the perceptual system generates, given a specific physical spatio-temporal energy pattern as input, an output that is organised in terms of semantic categories. Accordingly, the problem of perceptual semantics has not even been recognised by the *Standard Model* as a serious theoretical challenge because it is concealed precisely by one of the eminent achievements of our brain, viz. the externalisation of its own semantic categories into what we regard as the external world.

During recent decades, however, more appropriate conceptions have emerged in a converg-ence of empirical findings and theoretical ideas from ethology, research with new-borns, perceptual psychology and cognitive science. These conceptions, which were foreshadowed by Gestalt psychology and theoretical insights during the 17^{th} century, provide a theoretical framework for perception that radically deviates from the *Standard Model*. I will briefly and in an unavoidably oversimplifying way sketch this conception and then deal with those of its feature that I consider as essential for explanatory accounts of phenomena pertaining to *intrinsic multiperspectivity*.

This conception acknowledges, in line with a growing body of experimental evidence, that we can only deal in an explanatorily adequate way with the *Fundamental Problem* of perception theory when we are willing to subscribe to the perceptual system a biologically given conceptual structure that is rich enough to account for its core perceptual achievements. The exceedingly rich set of complex conceptual forms in terms of which we perceive our 'external world', such as 'surface', 'physical object', 'intentional object', 'event', 'potential actor', 'self', or 'other person' , with associated attributes such as 'colour', 'shape', or 'emotional state', and their appropriate relations, such as 'causation', 'intention', or, in the case of 'event', 'precedence', 'beginning', 'end', or 'subsequence', cannot be derived, by whatever mechanisms of inductive inference, from the elementary sensory predicates delivered by the senses. (It is important to be aware that these linguistic appellations of the conceptual forms of the *Perceptual System* and of their attributes and relations are only makeshift descriptions of non-linguistic entities whose specific nature has to be revealed by empirical investigations.) We thus have to assume that the perceptual system is biologically endowed with a rich perceptual 'vocabulary' in terms of which the signs delivered by the senses are exploited. It is, therefore, useful to distinguish at least two levels of abstraction with respect to the functional architecture of the perceptual system, namely a *Sensory System*, on the one hand, and *Perceptual System*, on the other hand (as illustrated in Figure 2).

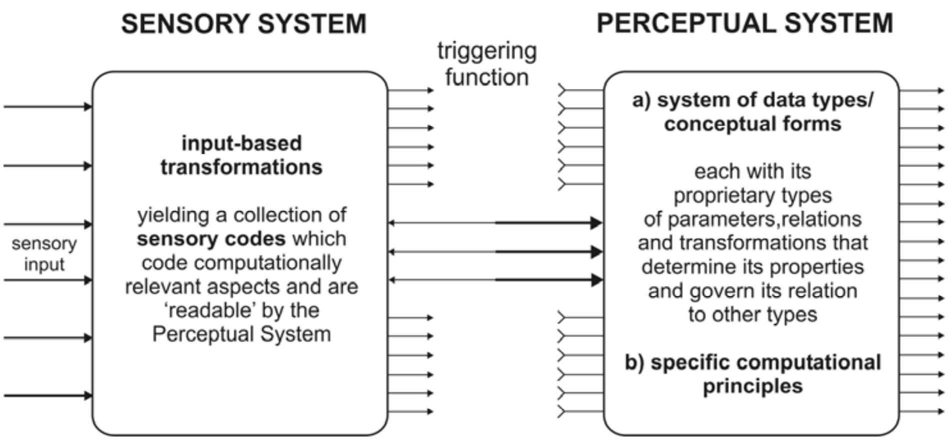

Figure 2: Functional architecture of the perceptual system

The distinguishing feature of the *Sensory System* is that the data formats on which its computations are based can be entirely defined in terms of the elementary physico-geometrical language in which we describe the geometrically organised sensory input, i.e. in terms of lines, gradients, texture, contour, luminance. The *Perceptual System*, on the other hand, contains the rich set of complex conceptual forms (such as 'perceptual object', 'surface', 'food', 'enemy', 'tool', 'causal event', etc.) that are not definable in terms of the conceptual forms of the *Sensory System* or reducible to them. These conceptual forms thus define the entities or abstract objects for the internal computations of the *Perceptual System*. They are the basis for our 'perceptual ontology' and thus constitute the realm of 'perceptual objects'. We can conceive of the *Perceptual System* as a self-contained system of 'perceptual knowledge', an "integrated complex represented in the mind" which pertains to "a specific domain of potential fact, a kind of mentally constructed world" (to borrow Chomsky's, 1981, p. 6, description of a different subsystem of the mind). We can refer to what is coded in the structure of its conceptual forms as the *'internal semantics'* of perception. According to the architectural conception proposed here, core aspects of most types of the explanatorily required build-in 'knowledge' as assigned to "core knowledge systems" by Spelke (2000) or to "conceptual-intentional systems" in the minimalist program of linguistics have to be imputed to the *Perceptual System* already. At the core of this theoretical conception is the idea that, in more complex organisms, perception is based on an internal computational organisation in terms of abstract data types or conceptual forms, and that the sensory input serves as a kind of sign for the activation of these biologically given conceptual forms, which constitute the data formats of the computational processes involved.

The *Sensory System*, understood in the technical sense used here, deals with the transduction of physical energy into neural codes and their subsequent transformations into codes that are 'readable' by and fulfil the structural and computational needs of the *Perceptual System*; we can refer to these codes as 'cues' or 'signs'. For each given sensory input, all codes that are computable from this sensory input by the available computational apparatus and that can be 'read' by the *Perceptual System* are simultaneously provided at the interface to the *Perceptual System*. Thus, the *Sensory System* can be understood as providing a specific subset of the (infinitely many) relations etc. of the sensory input, namely that subset that can be computationally exploited by the *Perceptual System* in terms of its conceptual forms.

The output of the *Perceptual System* consists of structured entities that are generated by its proprietary computational machinery and that represent legible instructions for subsequent systems by which interpretations in terms of external world properties are rendered. The instructions provided by the *Perceptual System* are exploited and 'interpreted' by subsequent interpretative systems (which include belief systems and systems comprising non-perceptual knowledge about the world), systems for imaginations, or systems by which the phenomenal percept is generated. Thus, the *Perceptual System* provides at its interfaces to higher-order interpretative systems options for exploiting activated conceptual forms in terms of the conceptual forms and computational requirements of these higher-order systems. A demarcation between the *Perceptual System* and higher-order interpretative systems is much more difficult to achieve than between the *Perceptual System* and the *Sensory System*. Hence, the line of demarcation depends to some extent on theoretical and meta-theoretical preferences. At any rate, operations which enable us to refer to properties of our external world and thus the computational and conceptual apparatus for externalising, as it were, the conceptual forms of the *Perceptual System* have to be assigned to higher-order interpretative systems rather than to the *Perceptual System* itself.

The conceptual forms of the *Perceptual System* can be understood as those data formats underlying its computations that are ‘visible’ at its interfaces with subsequent systems and thus can be ‘read’ by those systems. However, the output of the *Perceptual System* cannot be expected to be *fully* expressible in terms of higher-order interpretative and phenomenal systems. Rather, it can be used by other internal systems, such as ones sub-serving motorial purposes, and remain partly phenomenally silent, or un-interpreted by higher-order interpretative systems.

Whenever we talk about perceptual information processing or about computational processes we have, by necessity, to make explicit the kind of data formats or conceptual units on which these processes operate. Internal operations, relations and transformations can only be defined with respect to specific sets of data formats (or, more abstractly, conceptual forms). Unless we identify, in line with metaphysical empiricist presumptions, these data formats with the physico-geometrical data format that we use for describing the sensory input, or, in line with our build-in naïve realistic inclination, with the way we describe our ‘external world’, we have to regard it as the core task of perception theory to identify the nature of these data formats.

Ethology, perceptual psychology, and research with new-borns and babies have provided, notably in more recent studies, a rich and fruitful basis for theoretical speculations about the nature of the conceptual forms underlying perception. These speculations can only be regarded as fruitful to the extent that they contribute to a core task of perception theory, viz. the development of an explanatory framework of sufficient *explanatory depth* and *explanatory width* for a range of basic phenomena. Due to this requirement, regarded as a matter of course in the natural sciences, any confidence in corresponding theoretical speculations will not be based on isolated experimental findings but rather on a deeper convergence of quite different disciplines on a joint theoretical perspective.

Of course, the theoretical picture whose contours are presently emerging at the horizon is still faint and inevitably speculative. I cannot evaluate here the abundantly rich empirical evidence that speaks in favour of this picture. Since my agenda here is primarily programmatic in character, I will attempt to venture some ideas about the nature of conceptual forms that appear to me theoretically motivated and empirically warranted on the bases of what can be distilled from experimental findings in various domains.

The conceptual forms of the *Perceptual System* can be investigated with respect to various aspects. I will briefly address structural aspects, i.e. aspects of their logical form, their dynamical role in structure-building computational processes within the *Perceptual System*, and the question whether such conceptual forms can be assigned some biological plausibility from an evolutionary point of view.

As to the structural aspects, I have to confine myself to a few more intuitive remarks guided by conceptual considerations because our current understanding is too poor as to make any attempts at a more formal characterisation premature (this situation is exacerbated by the problem that, for well-known reasons, conceptual forms cannot be defined by the extensional notion of a set of objects). On the assumption that the biological system under scrutiny can be regarded as a computational one, we can conceive of the conceptual forms of the *Perceptual System* as abstract structures, each of which has its own proprietary types of parameters, relations and transformations that govern its relation both to other conceptual forms and to sensory codes. The values of the free variables of a conceptual form in general will not be - and, for subsequent computational processes, need not be - exhaustively specified by the activating input.

Empirical evidence furthermore indicates that the conceptual forms of the *Perceptual Systems* can be classified into different types. Types are sets of computational objects with uniform behaviour which usually can, in the meta-language we employ, be named (e.g. ‘surface’). Types are associated with constants, operators, variables, and function symbols by which they code the constraints on the computational processes associated with certain ‘perceptual objects’. For instance, computational processes associated with ‘perceptual objects’ of the type *‘living animal’* pertain to internal causal analyses in terms of ‘hidden powers’ and ‘essences’ of those types of objects; computational processes associated with ‘perceptual objects’ of the type *‘mykind’*, pertain to causal analyses in terms of ‘mental states’. The hierarchy of types constitutes the build-in knowledge about entities, situations, actions, perspectives etc. of our perceptual world. Conceptual forms and their associated computational processes provide a ‘grammar of vision’, as it were. “Employing this ‚grammar of vision‘ - largely innate - higher animals are able to ‚read’ from retinal images even hidden features of objects, and predict their immediate future states, thus to ‘classify’ objects according to an internal grammar, to read reality from their eyes“. (Chomsky, 1975, p. 8) From the theoretical perspective propose here, there is no difference of principle, with respect to the fundamental mode of operation of the perceptual system, between the perception of material properties and the perception of, say, mental states of others.

Conceptual forms can be regarded as semantic atoms of the internal semantics of perception, as the core semantics of minimal meaning-bearing elements. They form semantic and syntactic molecules and constitute, together with the computational apparatus of the *Perceptual System*, the combinatorial language of perception, as it were. The *Perceptual System* can be expected to have its own computational and generative principles for the structure-building processes by which systematically related patterns of activated conceptual forms are generated, in particular principles that pertain, e.g., to an evaluation metric, to the satisfaction of internal constraints, or to more global coherence constraints. For instance, perceptual phenomena suggest that it possesses a rather idiosyncratic evaluation metric (as mirrored in phenomena traditionally discussed under the heading of ‘cue integration’) and likewise idiosyncratic principles by which it glues together fragmented structures of activated conceptual forms into a globally more coherent structure (as witnessed, e.g. by phenomena pertaining to so-called impossible objects, or to the ‘dual nature’ of picture perception). Conceptual forms are organised in highly hierarchical structures. They comprise, as part of their structure, relational parameters which act as computational synapses, as it were, to other computational forms and whose values define the strength of the intrinsic connections between conceptual forms. Accordingly, conceptual forms build systematically connected packages whose nature expresses the kind of build-in ‘knowledge’ of the *Perceptual System*; also the activated conceptual forms offered at the interface to higher-order systems come in systematic bundles.

Because of the highly abstract and logically complex nature of conceptual forms, adherents to the *Standard Model* tend to regard them as biologically implausible entities and thus as explanatorily unwanted and dubious concepts for perception theory. However, which kind of theoretical notions are biological plausible and which are not, cannot be assessed in an a priori way but only by the explanatory success of an entire theoretical framework. Within the framework of evolutionary biology, independent lines of theoretical arguments can be discerned by which the biological emergence of abstract data types or conceptual forms can be motivated. These arguments are based on the observation that modularity, in some form or the other, presumably is, at all levels of biological organisation, the basis for the evolvability of complex systems and a driving force in their evolution (e.g. Kirschner & Gerhart, 1998). Accordingly, we can also expect computational systems, such as those subserving perceptual achievements, to exhibit a high degree of modularity with respect to the data structures over which the corresponding computations are defined. An evolutionary increasing differentiation or specialisation of computational subsystems mediating between the front end side of sensory transduction, on the one hand, and the motoric effector side, on the other, will accordingly yield an increasing number of interface problems that the system has to solve as a result of its increasing modularisation. For organisms with the simplest types of nervous systems, we can observe that the integration of different sensory channels is kept to a minimum, as required for instant motor control and action selection. An example are Cubozoans or box jelly fishes, which possess 24 eyes of 4 different types, where each type presumably serves a different adaptive function (Nilsson et al, 2005; Jacobs et al., 2007). Computationally more thorough degrees of informational or conceptual integration in organisms with multiple sets of eyes can be found at higher evolutionary levels of neural organisation (e.g. in jumping spiders, Harland & Jackson, 2000). For organisms with more complex nervous systems, comparative neurobiology and ethology offer many findings that indicate that the same type of sensory input can be exploited by different computational subsystems, each having its proprietary data type, apparently without being conceptually integrated in a more thorough and comprehensive way (cf. Tinbergen’s, 1951, classical example of the egg-roll behaviour of the grey goose, which presumably employs, depending on context, two disparate and apparently not integrated concepts with different triggering conditions, namely ‘egg outside of the nest’ vs. ‘egg inside the nest’). Although our current knowledge of the evolutionary emergence of abstract data types/conceptual forms (also referred to as ‘symbolic representations’, e.g. Gallistel, 1998) is still wanting, we can infer some general features from synchronic investigations of extant species as well as from insights into the role of internal (i.e. non-adaptational) physical principles in evolutionary processes (e.g. Kirschner & Gerhart, 1998; Kitano, 2004; Wagner, Mezey & Calabretta, 2005; Newman & Bhat, 2009), principles that presumably have their analogues on computational levels of biological systems. On the assumption that complex perceptual systems are computational systems and that modularity, with respect to corresponding data formats, is a driving force for their evolutionary differentiation, abstract data types will likely emerge as a consequence of internal computational and physical requirements of the functional organisation of the evolving system. In the course of an increasing evolutionary differentiation of the neural substrate that processes the information from various sensory channels, the system is increasingly faced with the functional demands of computationally tying together different subsystems by a joint data format that is sufficiently abstract for an integration of the information provided by different subsystems. While conceptually shallow interfaces may suffice in simple systems, in which different subsystems can be closely tied to single adaptive functions, such as recognition of prey, of mates, or of conspecific rivals, more complex system would yield an increasing number of executive conflicts at the motorial interface unless they exhibit an appropriate degree of inferential and conceptual integration between different subsystems. In this sense, the biological tendency for an evolutionary increasing amount of modularisation spurs and enforces, with respect to computational systems, an increase in data abstraction and hence the development of conceptual forms. Because a data type together with its associated operations can be regarded as a computational module, the availability of conceptual forms themselves can be regarded as an extreme variant of modularity.

If, as seems not unreasonably to conjecture, conceptual forms are evolutionary brought forth by internal computational requirements, their specific forms are not solely constrained by the adaptive requirement of coupling the organism as an entirety to its environment. Rather, the specific structure of the conceptual forms underlying perception will most likely be essentially co-determined and shaped, within the apparently rather broad latitude of design options that are left open by global adaptational restrictions, by powerful internal constraints that arise during the evolutionary development of a system of this complexity. Accordingly, the conceptual forms on which the computations of the *Perceptual Systems* are based have their own properties, which can be rather surprising when viewed exclusively from the perspective of an adaptive coupling to the external world. In fact, the most complex perceptual achievements, such as seeing invisible properties of objects (e.g. material qualities), intentional properties of objects (e.g. tools), or mental states of others, only became possible by evolutionary *decoupling* the output of the *Perceptual System* from the information provided by the sensory codes and by furnishing the *Perceptual System* with its proprietary types of abstract data types or conceptual forms.

Finally, I will address some dynamical aspects of the structure-building computational processes of the *Perceptual System.* The computations within the *Perceptual System* are instigated, via a triggering function between the *Sensory System* and the *Perceptual System*, by the sensory codes caused by a given sensory input. We can intuitively think of the triggering functions as an interface function that takes specific sensory codes as an argument and calls conceptual forms (cf. Figure 2). This intuition, however, is not entirely appropriate because it neglects the dynamic bi-directional aspect of this function by which conceptual forms search, as it were, for satisfying conditions of sensory codes. On the theoretical account proposed here, the sensory codes serve a twofold function. They activate, via the triggering function, appropriate conceptual forms and thus determine the potential data formats in terms of which input properties are to be exploited. Furthermore, they assign concrete values to the free parameters of the activated conceptual forms. Such a description, though, is much too static to capture, in an empirically adequate way, the computational achievements of the *Perceptual System*. Actually, a satisfactory theoretical account of the structure-building processes within the *Perceptual System*, by which outputs are generated that are legible to higher-order systems, has to provide something in its explanatory toolkit by which we can cope with the dynamic aspects and the "creative forces" (v. Szily, 1921) of perception. These aspects pervade the entire realm of perceptual phenomena, although they rarely become phenomenally salient. We can, however, notice them in a more perspicuous way in phenomena pertaining, for instance, to context-dependent reorganisations of part-whole relationships, or to re-conceptualisations of 'perceptual objects' and their 'parts', and in all situations in which ambiguities or perceptual vagueness occur. Any explanation of such phenomena requires the availability of special computational means and of conceptual forms with structural properties that promote and boost these dynamic properties. Corresponding intuitions about dynamic conceptual forms stretch back to Descartes, Humboldt (with his emphasis on active structure-building *"energia"),* and Cassirer. Despite the overwhelmingly rich empirical evidence fostering such intuitions, we are still lacking appropriate scientific conceptions for capturing these 'active', abductive and dynamic elements of perception in a more precise and explanatory adequate way.

The general theoretical perspective adopted here, which focuses on conceptual forms and their triggering functions, prompts to derive from experimental findings and phenomenological observations some preliminary speculations about potential structural aspects of conceptual forms that yield or support these highly context-sensitive dynamic properties of the *Perceptual System*. A structural aspect that suggests itself is the option to leave values of parameters undetermined by the input (or to only constrain them to regions of their associated parameter space). It is the presence of un-interpretable elements that makes conceptual forms 'computationally active' (in the sense that they are probing, as it were, the available sensory cues), and they remain active as long as they contain such elements demanding satisfaction. If a triggering function would yield an activation pattern of conceptual forms that completely specifies all values of parameters and satisfies all internal constraints of the *Perceptual System,* no further structure-building would be required. If, however, constraints are violated or undetermined values of parameters remain, further structure-building by computational processes is required, involving appropriate evaluation functions.

Experimental findings (for striking cases see, e.g., Tse, 1999; Spelke, Breinlinger, Jacobson & Phillips, 1993) as well as phenomenological observations indicate that the *Perceptual System* seems to routinely operate semantically with underdetermined conceptual forms. There is every indication that this structural feature is a general property of conceptual forms that extends to subsequent systems. Consider, for example, systems by which phenomenal percepts are generated. From a naïve perspective, one could be tempted to assume that these systems assign a semantically fully and uniquely determined phenomenal percept to the output of the *Perceptual System*. In fact, however, the ubiquitous phenomena pertaining to vagueness, indeterminacy or uncertainty indicate that the underlying conceptual forms inherit the underspecifications, with respect to a given input, of the conceptual forms of the *Perceptual System*. The output of the Perceptual System, at its interfaces to subsequent systems, thus needs not to be semantically determinate or unique but only 'good enough' for the semantic needs of the subsequent systems.

With respect to the possibilities of lacking specificity and semantic determinateness, it is useful to roughly distinguish, among the entire spectrum of types of underspecification, global and local aspects. Global aspects of underspecification pertain to an entire perceptual 'interpretation', as determined by a systematically related bundle of conceptual forms. Local aspects pertain to features of individual abstracts objects that belong to an activated systematic bundle of conceptual forms. Accordingly, we can speak of globally underspecified (bundles of) conceptual forms and locally underspecified conceptual forms. Local underspecifications in otherwise globally determined 'interpretations' pervade almost all aspects of perception; mostly, the underspecification is never completely resolved or only resolved in the context of specific tasks. By contrast, global types of underspecification are not as prevalent and seem to require the kind of input situations that are associated with phenomena of multiperspectivity.

All forms of underspecification convey constitutive computational advantages to the perceptual system. By postponing disambiguation to higher-order interpretative systems, the *Perceptual System* can increase its global stability with respect to the superordinate 'interpretations' provided at its interfaces to subsequent systems. This protects the system from settling, under insufficient or 'impoverished' input situations, on some definite 'interpretation' that would have to be changed to an entirely different 'interpretation' following a small variation in the input. In addition, and independent from issues of the handling of impoverished input situations, underspecified conceptual forms boost the potency of generative processes and enhance the conceptual versatility of the *Perceptual System*. By routinely operating with underspecified conceptual forms, computations can be performed on different levels of semantic granularity. The computational advantages of the capability of performing semantic operations over underspecified conceptual forms have been, albeit in different theoretical frameworks, profitably explored in computational semantics (e.g. Pinkal, 1996; Pustejovsky, 1998).

The theoretical picture underlying this way of framing core issues of perception evidently differs considerably from prevailing ones. It reverses the traditional perspective and approaches perception rigorously from within outwards, as it were. Needless to say that in the light of what is currently at all well understood about fundamental principles underlying perception, the framework adumbrated is inevitably highly speculative. Yet it appears to me well-motivated in the light of forceful theoretical arguments that can be advanced in favour of it, as well in the face of a great variety of impressive empirical evidence supporting it. Presently, however, only the contours of a theoretical picture have become faintly visible by the current convergence of different disciplines. More specific ideas and hypotheses can only be ventured in the course of enquiries that systematically explore the purview and fertility of this theoretical framework. Here, I have to content myself with intuitively illustrating, using the Heider-Simmel phenomenon as an example, the potential fecundity of the proposed theoretical stance. While traditional accounts of perception are fundamentally ill-equipped to deal with aspects of meaning, multiperspectivity, and perceptual vagueness, attributing them essentially to 'higher-order' cognitive systems, the direction of enquiry outlined above promises a natural way of approaching them as intrinsic properties of the perceptual system proper.

IV. Intrinsic multiperspectivity as the activation of multiple layers of underspecified conceptual forms

The property of intrinsic multiperspectivity will emerge as a direct consequence of the type of functional architecture roughly indicated in Figure 2. In contrast, this property will be will-nigh absent in simpler types of nervous systems in which the same type of sensory input can be independently exploited by different subsystems and simultaneously used for different task but in which the integration of different subsystems is kept slim. Intrinsic multiperspectivity only shows up in more complex systems, in which an increasing number of modular subsystems with a rich computational machinery have been evolutionary interposed between the sensory input, on the one hand, and the behavioural effector systems, on the other hand. As a consequence of their qualification as a computational system, such systems have to be furnished with sufficiently abstract data types/conceptual forms over which their computational processes are defined. Due to the availability of abstract data types, these systems are prone to exhibit a pervasive and profound degree of inferential and conceptual integration. Because conceptual forms become increasingly decoupled from specific sensory inputs in corresponding architectures, it becomes almost unavoidable that each given sensory input yields a (partial) activation of a great variety of different types of conceptual forms. On the assumption that conceptual forms with a sufficient degree of activation are offered, at the corresponding interfaces, to higher-order systems, phenomena pertaining to intrinsic multiperspectivity are inescapable in these types of functional architecture.

While we can have some confidence, or so I believe, in the appropriateness of the general idea that the core principles of perception pertain to a triggering of conceptual forms, our understanding of the specific nature of these forms and of the associated computational mechanisms is still extremely thin. However, some more superficial aspects of the basic logic of an internal handling of underspecified conceptual forms can be illustrated by the Heider-Simmel phenomenon.

As is apparent from the phenomenal percept, the same sensory input, viz. that provided by the Heider-Simmel movie, is exploited by two different types of conceptual forms, one pertaining to non-living physical objects and their attributes, the other pertaining to living objects of the type *'mykind'* (or *'agent'*) and their internal attributes. Both types of conceptual forms are underspecified by this kind of sensory input. In particular, in conceptual forms of the type *'mykind'*, intrinsic parameters for attributes pertaining to faces, eyes, limbs etc. cannot be specified by the given input. Rather, sensory codes pertaining to form aspects actually impede an activation of these types of conceptual forms. At the same time, sensory codes pertaining to motion patterns evidently foster an activation of the type *'self-propelled object'*, *'agent'*, or *'mykind'*. Apparently, the *Perceptual System* attaches, with respect to the activation of these types of conceptual forms, more weight to the corresponding motion codes than to the form codes, in this situation. For conceptual forms of the type *'non-biological physical objects'*, the triggering situation reverses. Here, the sensory codes for motion aspects vitiate an activation of these conceptual forms because the specific motion properties of the input violate internal constraints of the kinds of causal analyses associated with these types of conceptual forms (see Figure 3 for an illustration of this triggering condition).

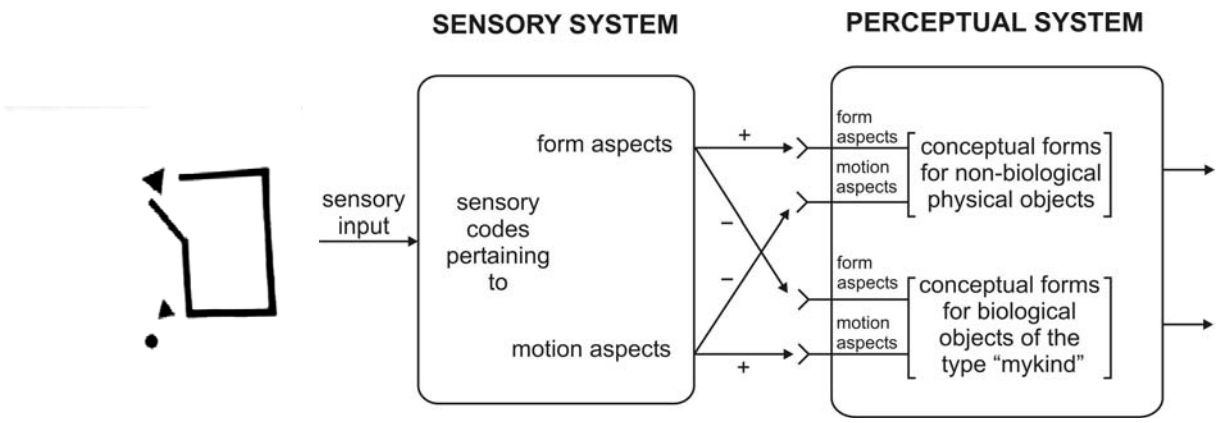

Fig. 3: Differential triggering of two different conceptual forms by the Heider-Simmel movie

This broad description of the triggering situation is first of all a specific way of framing theoretical questions that arise in the context of the Heider-Simmel phenomenon. It is, needless to say, a far cry from being an explanation of it. An explanation would have to refer to independent descriptions of the nature of the conceptual forms involved and of the specific triggering function. Furthermore, it has to address, e.g., issues regarding the integration of sensory codes, the integration of the violations of various types of internal constraints, the computational means by which various fragments or aspects are brought together into a globally coherent pattern, and local and global evaluation functions. However, Figure 3 makes clear that intrinsic multiperspectivity emerges as a natural feature within the assumed kind of functional architecture. The same input can simultaneously yield multiple conflicting ‘interpretations’ at its interfaces to higher-order systems. In each of these conflicting ‘interpretations’, part of the input or the sensory codes remains un-interpreted (either the self-motion of the objects and the kind of trajectories, or the form of the objects that carry intentional attributes). This is illustrated by Figure 4.

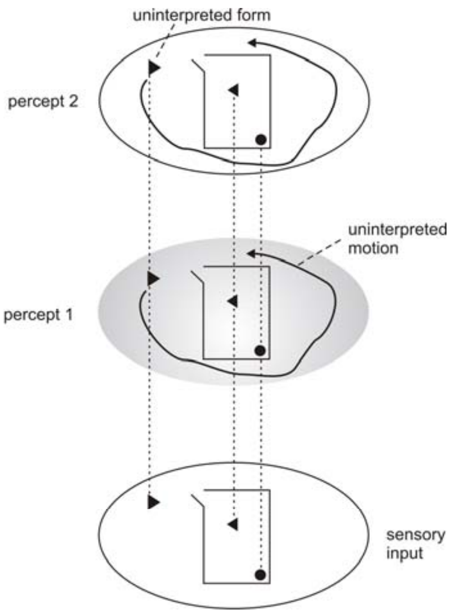

Fig. 4: Layers of conflicting perceptual ‘interpretation’ triggered by the same sensory input

While the number of simultaneous ‘interpretations’ provided by the *Perceptual System* is in principle only limited by the number of systematically connected packages of conceptual forms, computational requirements (pertaining, e.g., to stability aspects) and limitations of subsequent systems (in particular attentional ones) will reduce it to a very small value, usually down to 2. Each of these ‘interpretations’ embraces its own types of perceptual attributes; thrives in its own global framework; and is accompanied with its own degree of ‘realness’.

The theoretical picture tentatively explored here helps to understand the important fact that (contrary to misconception that dominate reigning conceptions) ‘realness’, or rather ‘unrealness’ is a purely internal attribute that is assigned, on the basis of internal evaluation functions, to ‘interpretations’ offered by the *Perceptual System*. The evaluation functions for assigning degrees of realness will presumably belong to higher levels at which phenomenal percepts are generated. The triggering conditions for the assignment of the global attribute ‘real’/’unreal’ can be quite idiosyncratic with respect to our ordinary intuitions about what is real. Furthermore, the degree of perceptual salience of an ‘interpretation’ of the *Perceptual System* and the degree of ‘realness’ can be largely dissociated. In the Heider-Simmel case, the perception as ‘agents’ with intentional attributes is more salient phenomenally; nevertheless, the ‘interpretation’ in terms of moving geometric objects is assigned a higher degree of ‘realness’.

Intrinsic multiperspectivity is not simply an odd by-product of the functional architecture of the perceptual system. It rather constitutes, for a system that is biologically endowed with a rich system of conceptual forms, an essential computationally element for dealing with internal problems pertaining to aspects of vagueness, ambiguity, and indeterminacy.
Its counterpart will most probably be found in all higher-order systems that take advantage of the output of the *Perceptual System*. Intrinsic multiperspectivity, in one way or the other, is a pervading property of our mental architecture. It is the foundation pillar of a stupendous range of capacities that allow us to simultaneously take conflicting perspectives in “looking at things and thinking about the products of our minds” (Chomsky, 2000, p. 36), capacities whose imprints range from simplest perceptual phenomena to our capability to reading or to employ metaphors or allegories.

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