

## Section 11 Implications

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## **11.1 Introduction**

The product semantic framework is derived from a historical, philosophical, theoretical and methodological critique of a particular conception of design that it regards as typifying the dominant paradigm underlying recent and current design theory. The prevailing paradigm is production-centred, function-centred and locates the structure for product content and meaning in the intentionality of the design process. Product semantics argues (contra the paradigm) for a user-centred model, and draws on semantic and cognitive theory in its implementation. The present sections develop the product semantic approach (in the light of the conceptual re-orientation) both in the context of design theory, and in considering an experiential basis for semantic and cognitive accounts.

### **Section 11.2 and 11.3**

Section 11.2 (summary, section 11.3) considers the implications of the product semantic framework and the proposed conceptual re-orientation in the context of design theory and methodology. The 'prevailing paradigm' and the product semantic account are first contrasted by comparing outline models. The orientation of the framework is examined in respect of its key concepts (notably 'meaning' and 'affordance') and the hierarchical explanatory structure of the scheme expressed in a form commonly used in cognitive accounts. It is evident that the account fails to provide grounding either at the level of cognitive functioning, or in providing a model for the source of conceptual schemes in the socio-cultural order. The proposed conceptual re-orientation is similarly mapped and gives rise to two interacting hierarchical orders, jointly contributing to meaning relations which are conceived as the highest level in the scheme. Cultural production generally is located in the interactive space between orders, and can be regarded as an external element in cognitive functioning, operative at a number of levels, with products having a dual aspect - as 'signals' in co-ordination, and as experientially represented objects.

### **Section 11.4 and 11.5**

The commitment of product semantics to an experiential approach in the context of semantic and cognitive theory is not realised in the detail of the account, which ultimately emphasises conceptual and propositional structure. The analysis, and the arguments of the conceptual re-orientation allow for a reconsideration of the possibility of approaching semantic theory and cognition from the standpoint of experiential content. Section 11.4 pursues the question in the light of recent work relating to 'non-conceptual content', and 'feature placing languages' and the theoretical mapping of representational space. The conclusions are summarised in section 11.5.

## 11.2 Design Theory and Methodology

Product Semantics proposes a theoretical framework which is based on the idea that design can best be conceived, theoretically and methodologically, in terms of a semantic model of user-product interaction. The substance of the proposal consists in the assertion that the core articulating concept for the characterisation of a user centred process is 'meaning'. The value of the concept is taken to consist in its capacity to capture the idea of user perspective, which is elided in the central role given to 'function' in traditional accounts of design, and in its capacity to provide continuity between the role of products as elements in individual and in cultural expression.

The product semantic analysis of meaning draws on a number of constituent or contiguous concepts, including 'affordance', 'significance', and 'categorisation'. Each of these is intended to give shape to the interpretation of meaning relative to contexts perceived to be central to clarifying the nature of our individual and collective product interaction. The explication and use of these concepts gives tangible support to the stated commitment to a cognitive and experiential account of user interaction, founded on semantic analysis.

In section 9.2 (summarised in section 9.3) the core argument structure of the product semantic account, based on the earlier analysis of concepts, was presented. The collective deployment of concepts within the framework of this argument structure gives rise to inconsistencies which are identified in section 9.4 (summarised in section 9.5). In sections 10.1 - 10.5 proposals were developed which are intended to resolve the conflicting commitments, on the basis that there are distinct senses of 'affordance', 'meaning' and 'representation' which relate to different explanatory orders.

The present section considers the implications of the framework, and of the proposed resolution of internal inconsistencies, for design theory and design methodology.

### *Theoretical Orientation*

In broad terms the product semantic framework is conceptually contiguous with a number of identifiable trends within design philosophy and theory. In the first place it locates the problematic in design primarily in the context of consumption or reception,<sup>1</sup> rather than in

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<sup>1</sup> The principal source of this shift in focus has come from the history of design, and cultural studies more generally and is represented for example in the work of Forty in the field of design history [Forty 1986] and Appadurai and Miller in respect of cultural studies [Miller 1987; Appadurai 1986]. The product semantic account is founded in part on a historical and cultural critique [See above pp25-34]

production.<sup>2</sup> In so doing it emphasises the idea of the user rather than the consumer,<sup>3</sup> and regards products as elements in, or expressions of, socio-cultural complexes.<sup>4</sup> In addition it gives strong emphasis to the idea that individuals are not passive receivers but active participants in the construction of product content.<sup>5</sup> Nevertheless it is distinctive in respect of the ways in which this general stance is implemented, both in terms of the extent to which the form of design activity is modelled on user-interaction,<sup>6</sup> and in terms of the nature of the theoretical constructs deployed.<sup>7</sup>

### *User Interaction and the Design Process*

Product Semantics represents an attempt to provide a framework for design theory and methodology, ultimately grounded in terms of cognitive models. It does so in two ways. Firstly by identifying the creation of the interface between users and products as the core role of the product designer, and outlining the basis for a semantic and cognitive account of the interaction between users and products which is intended to underpin that role. Secondly by asserting that a design process which is centred on understanding user interfaces in these terms, implies the need for a linked set of (cognitive) models that are possessed and used by the designer.

Clearly the two claims do not have the same status. The first is essentially based on the assertion that users do interact with products in ways which can be characterised and explained in terms of semantic and cognitive models, and such a claim is susceptible to theoretical and empirical evaluation. The second, involves a commitment to the idea that a design process which takes proper account of the cognitive implications of user interaction requires the employment of certain cognitive models by the designer. Although

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<sup>2</sup> This contrasts with the production oriented approaches characterising an earlier stage in the development of design theory, represented for example in a wide range of related problem-solving and process oriented models [for example Alexander 1963, 1964; Archer 1965, 1970; Jones 1984]. The key articulating papers, which although production oriented attempt to provide the ground for more general and situated analyses include Simon's contributions to the idea of an integrated discipline for dealing with the artificial world [Simon 1969, 1984] and the problematisation of the implicit determinism and scientific ideologies lying behind design models [Rittel and Webber 1984]. The fruit of the intersection between such papers and the general move to a consumption orientation has been reviewed in the context of the general and pervasive idea of design as 'the liberal art of technological culture' in a number of papers by Buchanan [for example, Buchanan 1992, 1995].

<sup>3</sup> A theme which has been pursued more generally, for example in the context of the relation between culture and industry [Morello 1995] and in terms of definitions in marketing [Kotler 1987].

<sup>4</sup> Csikszentmihalyi and Rochberg-Halton 1981; Csikszentmihalyi 1991; Fry 1995; Margolin 1988, 1995. The need for design as a discipline to incorporate results and methodologies from the social sciences, which is a central theme of the methodological strand of the product semantic argument, has been pursued independently by a number of authors [for example, Frascara 1988; Papanek 1988].

<sup>5</sup> Belk et al 1989; Csikszentmihalyi and Rochberg-Halton 1981.

<sup>6</sup> The general position has an affinity with the emphasis given by some writers, notably Cross, to the idea of core capacities that are generally possessed, which underlie professional design activity [Cross 1982, 1984].

<sup>7</sup> The use of semantic and cognitive models in addition to the more generally used psychological and sociological models.

this latter claim is more complex (and formally untestable),<sup>8</sup> informally it broadly corresponds to the idea that there is an underlying parity in the nature of product interaction whether this involves users or designers, which can be unpacked either in terms of knowledge of what is involved in user-product interaction which is deployed by the designer, or in terms of the designer's ability to assimilate user-product interaction in the form of their own patterns of thinking.<sup>9</sup>

The central claim is the first - that user-product interaction can be characterised and explained in terms of product semantic models. The proposed framework for theory, that derives from developing this claim in detail, has a number of general characteristics. In the first place it is broadly ecological - the nature of user-interaction is that it is a situated complex, which needs to be understood by unpacking the elements of 'situatedness'. Secondly it is holistic rather than compositional - user-interaction involves grasping wholes directly rather than inferring them from data. Thirdly it is relativistic - the content of user-interaction is a function of an individual in a context. Fourthly it is experiential - the content of user interaction is a function of an individual's experience in a context.<sup>10</sup> The product semantic account identifies the incapacity of traditional design theory to encompass these essential characteristics, with the centralisation of the concept of 'function', and instead proposes 'meaning' and 'affordance' as the central concepts.

### *Design Model*

The framework is based on an explanatory argument structure which is implicit in the introduction, characterisation and deployment of a range of concepts and relations pertaining to user-interaction.<sup>11</sup> There is no comparable treatment of the design process per se, although the essential elements and relational structure of such a process are

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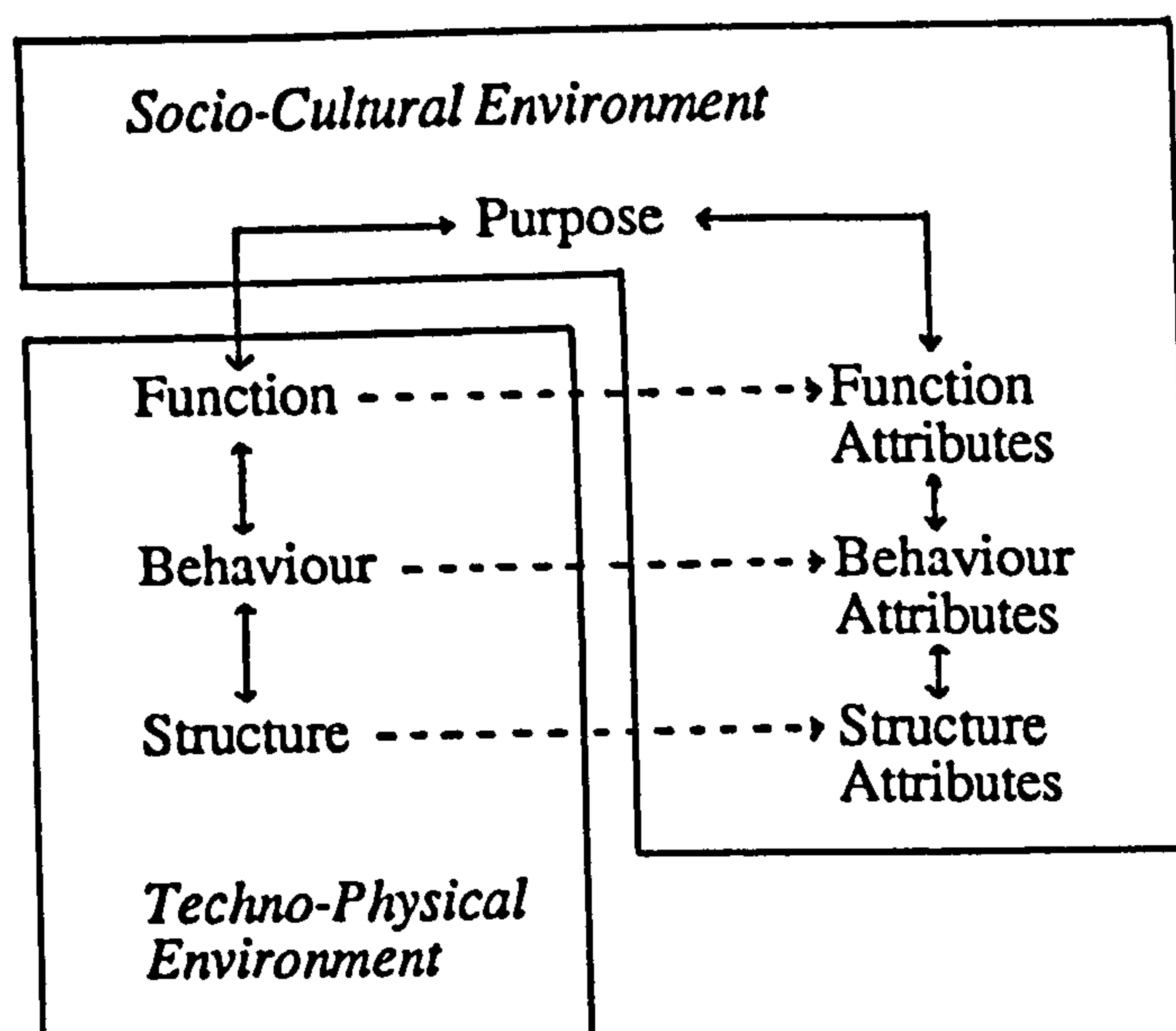
<sup>8</sup> The second is more complex in that although it does contain empirical and theoretical claims, their expression is embedded in an ideological commitment, which in this form cannot be theoretically or empirically evaluated since it is not clear from the product semantic account what would constitute a designer or design team deploying a set of cognitive models. Krippendorff appears to equate the deployment of models with a stance or attitude adopted by the designer, but expressed in cognitive terms (designer's cognitive models which are equated with the set of user's cognitive models)[Krippendorff 1989, pp 38-39]. Other authors tend to assume that knowledge of user's cognitive interactions are embodied in the design process in the form of procedures [See for example Butter 1989; Vihma 1995].

<sup>9</sup> Krippendorff's model lies closer to the latter alternative and is at times similar in tone to 'empathic' models of understanding, although expressed cognitively.

<sup>10</sup> These characteristics are not unique to product semantic approaches. A broadly ecological view of product interaction has for example been proposed by Manzini, drawing on the work by Bateson and Moles [Manzini 1995; Bateson 1972; Moles 1968]. A parallel sense of contextualisation which is more explicitly culturally oriented is also evident for example in Moles and in Margolin's conception of the 'product environment' [Margolin 1988; Moles 1985]. The nature of holistic engagement is clearly evident in Buchanan's doctrine of 'placements', although the discussion is centred on designers' rather than users' cognitive engagement [Buchanan 1992].

<sup>11</sup> See above, Section 9.2

implied by the role assigned to user models in the cognitive economy of the designer engaged in design activity. Some sense of what this might mean if it were to be expressed directly as a model of design, can be gained by comparison with a commonly used design model, which equates to the 'prevailing paradigm' identified within product semantics.<sup>12</sup> The selected model conceives human beings as operating within three environments - the natural, the socio-cultural and the techno-physical. The interaction between people and the natural environment, people and the socio-cultural environment (and their intersection) gives rise to issues which are addressed in the techno-physical (artificial) environment. If we accept the natural environment as the background of all our activities, then design can be conceived in terms of relations operating within and across the socio-cultural and techno-physical environments.<sup>13</sup> These are expressed as follows :-<sup>14</sup>



The relationship between environments can be expressed in terms of a semantic model by interpreting relations in the socio-cultural environment as semantic relations, and relations in the techno-physical environment as syntactic relations.<sup>15</sup> Design is therefore broadly

<sup>12</sup> See for example, pp 30-37 above. The purpose of the comparison is to gain some perspective on the product semantic design model relative to its own perception of the prevailing design paradigm, rather than to provide an independent analysis. The model selected is essentially that developed by Hybs and Gero, and expounded in the context of a broader background to design theory by Rosenman and Gero [Hybs and Gero 1992; Rosenman and Gero 1998]. The criteria for the selection of a model for comparison are:- a) that it should generalise across a broad range of function-centred models; b) that it should conform to the product semantic conception of the prevailing design paradigm; c) that it should be expressed in the form of concepts and relations, in order to facilitate comparison with the product semantic account; d) that in other respects it should be broadly consonant with the product semantic account, again to facilitate comparison.

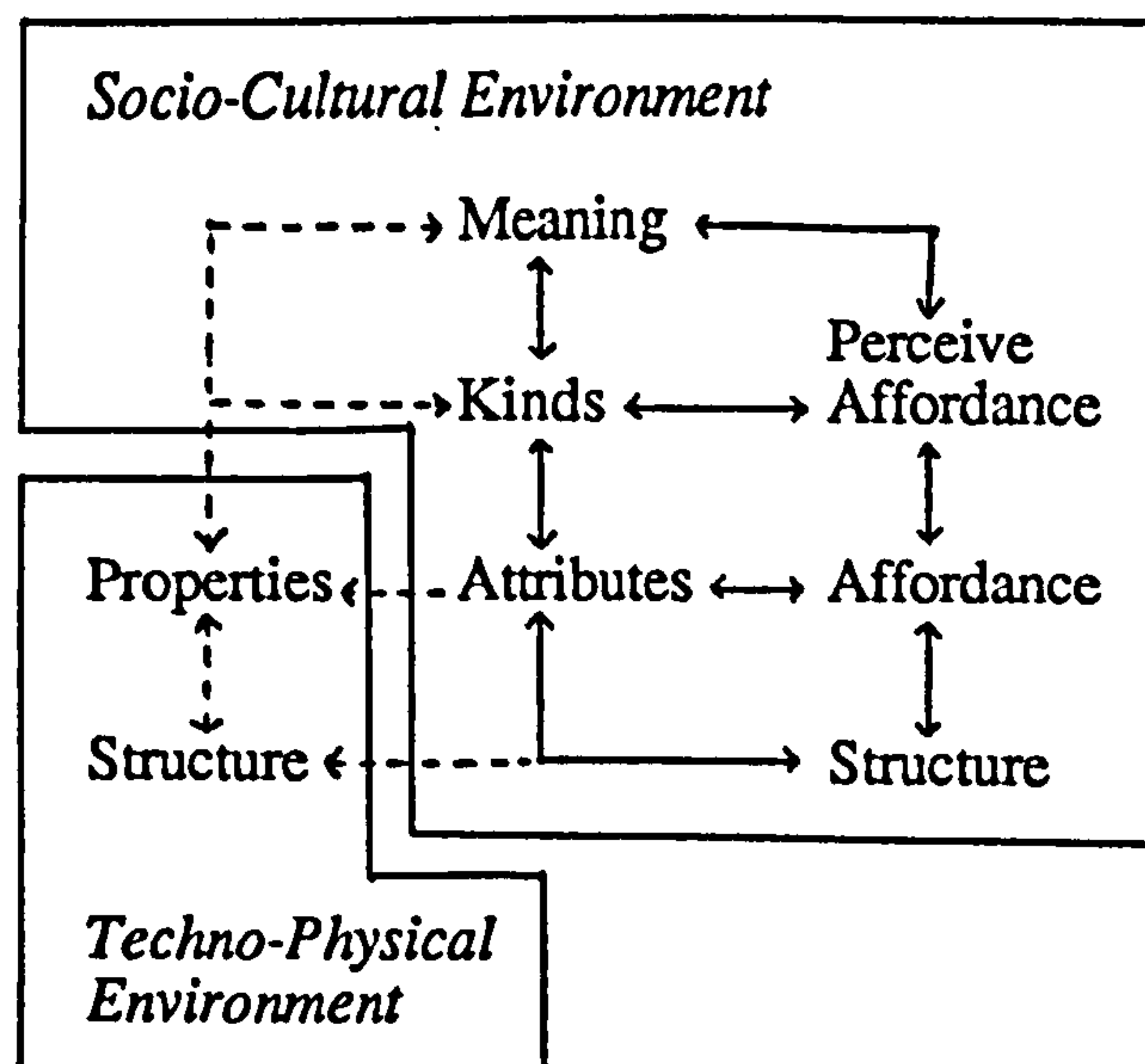
<sup>13</sup> This is not to ignore the fact that the natural environment is in a number of senses constituted in socio-cultural and techno-physical domains, nor that it is altered by our activities in these domains, which is a theme of both the present model and the product semantic account.

<sup>14</sup> Based on Rosenman and Gero 1998, p167, figure 3.

<sup>15</sup> They are interpreted in this way in the model [Rosenman and Gero 1998, pp 161-162].

and primarily concerned with the relation between formal properties and meaning under the umbrella of intentionality in the socio-cultural domain. At this general level the model, though clearly consonant with a number of features of the product semantic approach, also embodies the assumptions with which it is at variance. Firstly, the model is driven by design in the interpretation of intentionality in the socio-cultural domain (purpose), in terms of functions. Functions are in turn conceived as properties of the behaviour of structures (formal content), and therefore operate as the articulating elements between semantic and syntactic content. Secondly, the structure of the semantic domain itself is assumed to mirror the structure of the design domain.<sup>16</sup>

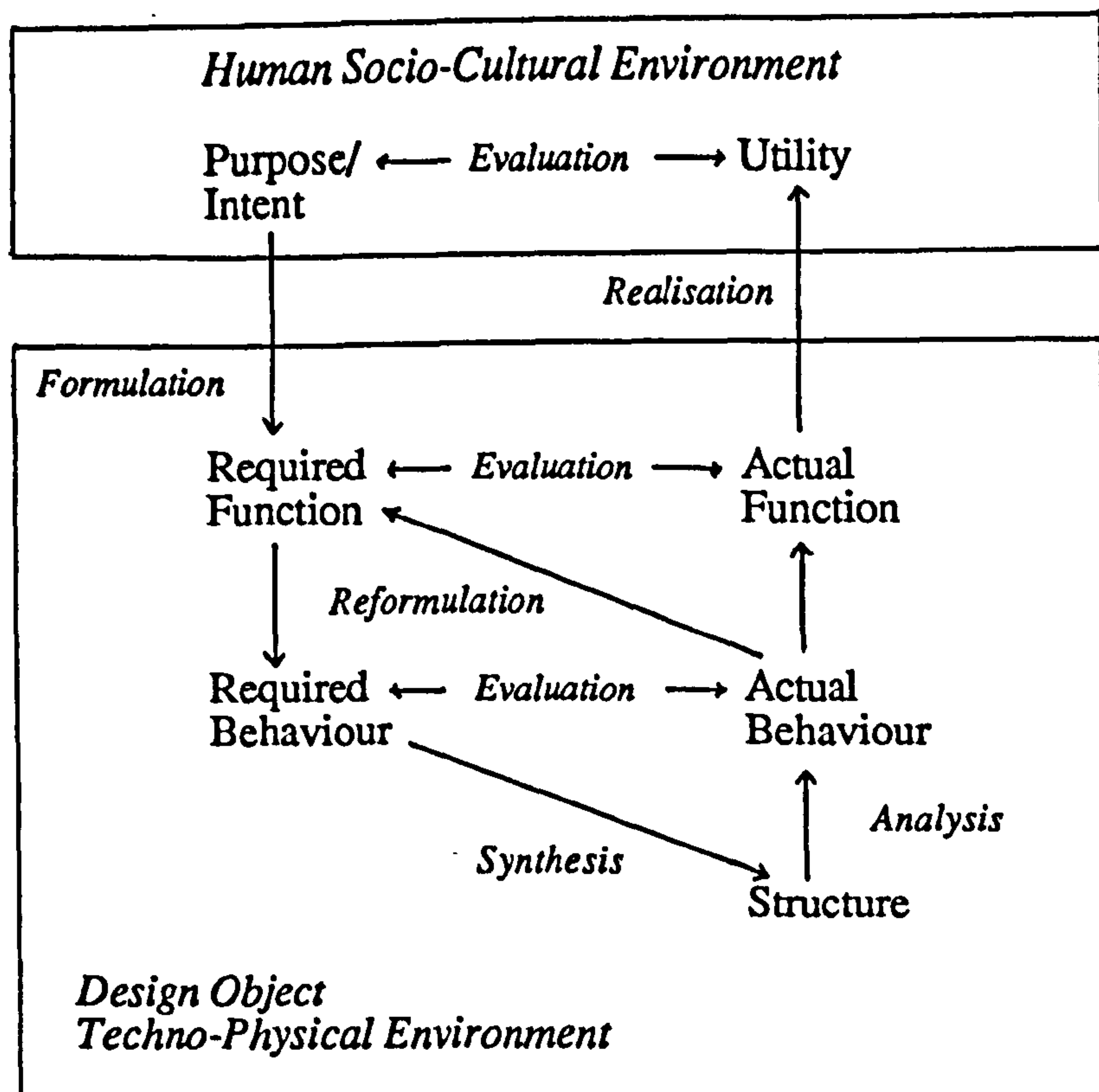
The product semantic account argues that neither assumption is justified and stresses the need to articulate the semantic domain in its own terms - in terms of the structure of meaning-making in user interaction - and to draw the implications from this in specifying formal content. This might be expressed in terms of a parallel diagram :-



The general idea is that the socio-cultural environment has a semantic structure which does not naturally conform to a function-centred model, but which is articulated in terms of meaning and affordance and in terms of which structure (formal content) is co-derived. The problem in the techno-physical environment remains that of specifying structure, but the relevant sense of structure is derived directly from semantic relations in the socio-cultural environment, rather than via syntactic relations in the techno-physical environment. This conforms broadly to the idea that the problematic in product design is located in the sphere of consumption rather than production.

<sup>16</sup> The semantic domain is conceived as structured in terms of attributes corresponding to the function-behaviour-structure cascade in the design domain.

Both models derive from a conception of semantic and syntactic relationships operating in and across broad contexts or domains. In the case of the 'prevailing paradigm' these relations are unpacked as process in terms of their inference structure. However, since direct inference is not generally possible (for example, 'structure' cannot be directly inferred from desired behaviour) the process can only proceed through an indirect set of relations which are expressed as follows :-<sup>17</sup>



The effect of this move is to localise design activity with the design object in the techno-physical environment, and to structure semantic relations in terms of the syntactic relations operating within that domain. In addition it limits the specification of design activity within the socio-cultural environment to the comparison of outcome with intent, and in product semantic terms therefore begs the key semantic question.

### *Meaning*

Product semantic accounts identify the key area of activity bearing on design as occurring within the socio-cultural environment, and taking the form of an explanatory framework for understanding user-interaction, which can relate formal content to the practical and conceptual utility of the product. This is approached in terms of meaning which is

<sup>17</sup> Rosenman and Gero 1998, Figure 4, p 173.



conceived as the collective of senses in which a product has significance from a particular perspective - it is what individuals and groups can 'make' of the product, what they can understand from it and what they can use it for. Meaning is therefore closely allied to understanding and use, and so deployed in a general and metaphorical sense, establishes the grounds for an alternative model.<sup>18</sup> In the first place it shifts the focus away from intended and correct use, to the idea of an open-ended interaction in which content is created rather than given. Secondly it emphasises 'perspective' in the sense that the product may be understood by stakeholders in different ways, who may thus arrive at different conceptions of content. Thirdly it points to the idea of product content in terms of what is offered to the user. Fourthly it does so in conceptual and instrumental terms.

In order to make use of 'meaning' other than as an extended metaphor, the concept needs to be unpacked, and its relation to other concepts made clear.<sup>19</sup> It is argued that just as language can be viewed as a special case of a more general system of signification, products and their contents can be understood as elements in systems of social communication and interaction, where meaning has two key components - identity and content (rather than sense and reference). But although a core sense of product meaning is acknowledged as residing in identity - 'what it is', the product semantic account is centred on the idea of content - 'what it offers' ('what I perceive it has that I can use').

### *Offers, Expectations, Perceive-Affordances*

In Product Semantics, the key design-related feature of user interaction is 'expectation'. The product engenders certain expectations in the user relating to performance, which may or may not be met. It will be clear that expectations are not simply 'givens' but are, at least in part, created in the interaction. Expectations are essentially responses to the physical features and behaviour of the product, in terms of their perceived potentiality. The actualisation of potential is expressed in terms of 'affordance' and construals of potentiality are explained in terms of 'perceive-affordance', both of which are conceived ecologically - expressing situated patterns involving user, product and context.

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<sup>18</sup> Product semantic accounts reject the identified paradigm generally, and the centrality of 'function' in particular on the grounds that it reinforces an intentionalist design-centred view, in which products are envisaged as embodying particular procedures in their formal content, which in turn encourages an inappropriately objectivised and mechanistic view of users and their practices.

<sup>19</sup> One obvious context in terms of which this might be achieved is the formal analysis of language (which underlies the metaphorical use of the concept). It is argued that since there is no language of design which is comparable with natural language or with a language of thought (in the sense of having a compositional formal structure), the sense of meaning familiar in philosophical and linguistic contexts, where reference and truth underpins its sense, is not directly applicable as a theoretical construct in product semantics.

The structure of our perceptual system is such that it is constituted in part by an ability to read the environment directly.<sup>20</sup> Perception is inherently rich in information content, and the action-oriented nature of that information is captured by the concept of perceive-affordance. We perceive the potential for surfaces to be walked on, sat on, climbed; for objects to be grasped, lifted and thrown. It is perceived directly rather than by inference and constitutes at least part of the product offer, and associated user expectations.

The Gibsonian concept of affordance, perceive-affordance and the ecological explanation of perception cannot readily be generalised as an explanatory framework for user encounters with products without considerable reservation and augmentation. A chair might be perceived as affording comfortable repose, in respect of the direct perception of the disposition and softness of its surfaces - a perception that might be shared with the features of a hollow in a grassy bank - but it is by no means clear that the cognitive significance of any artefact can be adequately accounted for in this way. Direct perception forms part of the cognitive game, but the recognition of type and the cultural history of both the type and the token are arguably more important factors in attributions of significance and expectation, than the underlying perceptual mechanisms that can ultimately be used to ground the general in the particular. Although certain attributes of the environment are directly perceived, their link to object identity, significance and meaning are constituted culturally. A soft chair and comfortable repose are associated through a complex history of personal experience and cultural roles that shape expectation at the level of product encounter to a greater degree than the information contained in direct perception, which necessarily operates at a level of far greater generality.<sup>21</sup>

There is nonetheless an important sense in which the insight offered by 'basic affordance' can and does usefully inform the product design process. In so far as direct perception reflects the action-centred bodily basis of all our physical and mental processes, it does provide a baseline of a kind for the mechanism in terms of which product features are interpreted. The form and scale of features invite or deter the kinds of physical interaction that we are inclined to make. Thus in the absence of more embedded socio-cultural cues,

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<sup>20</sup> Essentially in the Gibsonian sense of our directly perceiving potentiality for action, in terms of the juxtaposition of variants and invariants and the 'flow' of the perceptual array. This is evident in the nature of our ability to negotiate the environment, and constituted in the richness of a system geared to the detection of both global and local change in that perceptual array.

<sup>21</sup> The extension of Gibsonian notions of affordance and perceive-affordance to account for significance and meaning becomes ever more problematic as the variety of aspects of product encounter are elaborated. Thus although there is a simple sense in the idea that a chair affords sitting, there is no easy parallel between this and the idea that an abacus affords arithmetical calculation. It is certainly true that an abacus does afford arithmetical calculation, both in the sense that it is physically constituted to allow for a narrow cluster of relevant human behaviours and because it has proved to be highly effective in certain cultures for the purposes of arithmetical calculation. But the fact that it does so, depends on a complex cultural and intellectual etiology that almost entirely evades what is captured in direct perception. The majority of products have a content that is arguably closer in spirit to an abacus than a chair.

we will be inclined to grasp certain features in certain ways, on the basis of a primitive level of perceive-affordance.<sup>22</sup>

The problem with extending the scope of the concept of basic affordance is that, in the interest of asserting correctly that our perceptual and cognitive schemes are rooted in our physicality, the role of the conceptual in structuring and restructuring the significance of the physical may be underplayed. This is acknowledged and developed in the product semantic account, for example, in the use of the idea of 'meaning contexts' to express cultural and conceptual relativity. This is particularly important in product design, where the denotative aspects of product significance may be relatively deeply submerged in a sea of connotation, and where the role of products as physical embodiments of conceptual models plays a significant part in our general intellectual and emotional development.<sup>23</sup>

Potentiality as represented in expectation is grounded in two principal ways. It is grounded in the expectation associated with type identity, (which as the product categorisation model acknowledges is often functionally tagged). It is also operationally grounded via association, through affordance relations which are conceived as operating at a number of different levels.<sup>24</sup>

### *Affordance and Meaning Contexts*

The affordance-based mechanism of direct perception is perceived as operating at a deep level, providing a foundation upon which the superstructure of both cultural and

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<sup>22</sup> If the concept of affordance is taken at face value as though it were a Gibsonian primitive term, then the expectation engendered would be constituted in terms of body oriented conceptual primitives apprehended instrumentally. In the context of a visual first encounter, this might take the form of a sense or feeling that this feature can be grasped, that feature can be turned, and these potentialities might be related in such and such a way. These perceive-affordances will then be tested as the encounter shifts from perception to action, and the product will turn out to either afford or not afford the instrumental implications of its perception.

<sup>23</sup> Our interaction with products in such development is a reciprocal one and its possible nature represented, for example, in the philosophical stance of Hegel. [See above 'Product Models' pp 178-192]. In less philosophical and more cognitive terms, it may be related to the nature of concept schemas that pervade recent and current accounts of abstract conceptual categories. [See above 'Schemas' pp 164-167]. If products (things produced) and production (processes by which they are produced) contribute to our collective cognitive development in providing fundamental schemas for more abstract concepts through metaphorical extension, they also contribute to cultural differentiation and development through their capacity to be invested with significance through connotation, and for that significance to be lost, changed or hi-jacked [See for example the case studies in Thompson 1979; and Bonta 1973 reprinted in Broadbent 1980]

<sup>24</sup> The exceptions dig to the gibsonian roots of perceive affordance and take on the character of being 'to hand' in Heidegger's sense, but tend only to be harnessed in special circumstances, for example, where one needs something urgently. I need to prise open a locked door because someone is in danger and reach for a poker because I perceive it to have the right sort of qualities. In contexts such as these - urgency and improvisation, all the objects in the world lose their socialised quality and become as if 'natural', although it may take a great deal of cognitive effort to recognise the material or the quality in the product. The degree to which we are able to dissociate the potentiality of a brick from its identity becomes a measure of creativity.

individual significance can be built, and in terms of which it is structured.<sup>25</sup> This can be seen in considering the product semantic ‘levels of affordance’ and ‘meaning contexts’ which, though separately articulated, converge and can jointly be mapped to Dipert’s analysis of artefacts in terms of levels of intentionality :-<sup>26</sup>

	<i>Dipert</i>	<i>Krippendorff</i>	<i>Krampen</i>	
<b>Public</b>		<i>Mythology</i>		<b>Artificial</b>
	Products (Objects <sup>1</sup> )			
	<i>Affordance (perceptual<sup>1</sup>)</i>	<i>Ecology</i>		
	Artefacts			
	<i>Affordance (cognitive/normative)</i>	<i>Genesis</i>	<i>Social Affordance</i>	
	Tools			
	<i>Affordance (cognitive)</i>	<i>Language</i>	<i>Ritual Affordance</i>	
	Instruments			
	<i>Affordance (perceptual)</i>	<i>Use</i>	<i>Basic Affordance</i>	
<b>Private</b>	Objects			<b>Natural</b>

The simplest form of expression of levels is represented in Krampen’s account, where a bottom-up constructive approach involves the gradual socialisation of basic affordance. The mechanisms that allow this process of ascent to take place are essentially located in the conceptual structure inhering in social convention. Thus although a direct engagement takes place at ground level, it requires a conceptual scheme external to the terms of engagement for its structure, even though the idea of direct perception is retained. This is also apparent in Dipert’s scheme which is expressed in detail in terms of levels of

<sup>25</sup> The cognitive capacity underlying perceive-affordance is, at least in part, innate and constitutes a ‘deep structure’ and generative schema upon which particular construals of product expectation are founded and which to differing degrees involves experience, learning or cultural conditioning. The import of this and the appropriate level of its application in product semantics is a matter of equivocation in that whilst it is in one sense accepted as a deep structure that generally underlies the global aspects of perception and cognition, it is also taken as directly applicable to particular products and their features, in being concept driven.

<sup>26</sup> See above ‘Artefacts’ pp 194-195. The use of the superscript in the diagram (eg objects<sup>1</sup>) is intended to indicate the way in which at higher levels, engagement with products as part of an ecology of products is parallel to the engagement with objects as part of the natural order at lower levels.

intentionality, where the source of the intentionality lies in social convention.<sup>27</sup>

Krippendorff's account is more complex since it is articulated in terms of contexts for meaning making, which are not always taken to imply a levels structure.<sup>28</sup> In addition since they are also conceived as overlapping 'cognitive models', in a given situation they may be jointly and interactively engaged. Nevertheless it is possible to discern different kinds and levels of explanation. There is a basic sense in which our interaction with products can be conceived in terms of ground level physical and instrumental engagement and the perceptual structure associated with it, and that the idea of affordance is operative in some sense at this level. The conceptual organisation of this level is informed by the structure of language as an expression of social convention. Similarly the context of language relevant to products is informed by the context of higher order social interaction in which products are the focus for the articulation of social interactions themselves (the context of Genesis). At the extreme, products constitute a system of relations which have the sense of autonomy associated with the natural order.<sup>29</sup> This is expressed in terms of the idea of a product 'ecology'. At this level our relation to them becomes drained of content as they are engaged as though they were part of a second natural order.<sup>30</sup> In both accounts 'affordance' is deployed as the articulating concept at different levels of intentionality and social engagement.

### *Affordance and Explanatory Levels*

Affordance as the general expression of an ecological relation can be applied at a variety of levels of interaction. Its clearest role as a theoretical construct occurs at the level of the physical functioning of organisms, where it captures the complex set of interactions between system states and environmental values in terms of which selection takes place, and by direct extension in the context of teleological semantics, the non-conceptual

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<sup>27</sup> Dipert's account is more complex and fine-grained and involves the idea of interaction between instrumental properties of objects and socially grounded conceptual schemes. For example, he locates the idea of value and value systems in the 'fittingness' of the instrumental properties of things to their uses. The scheme is closely related to the thrust of the 'reconciliation' in the sense that there are two distinct sources of 'meaning' one located in instrumental interaction and the other deriving from social interaction. In addition there is a close parallel in Dipert's account to the idea that cognition is schema based. [See above pp 175-177 and Dipert 1993]

<sup>28</sup> Krippendorff sometimes represents the contexts as a nested set and sometimes as an overlapping set of models which are arranged hierarchically. Neither interpretation is totally consistent with the way in which the contexts are individually treated when they are expounded in more detail. The most sympathetic interpretation is that there is a basic hierarchy if the scheme is viewed developmentally, but in the actual operation of meaning making in an occurrent situation, they are mutually interactive.

<sup>29</sup> Comparable with the sense of a 'system of objects' in Baudrillard 1996.

<sup>30</sup> The highest level, which is not articulated as a cognitive model, is conceived in terms of the idea of mythology, which represents the large scale assumptions and schemas embodied in socio-cultural contexts, which are not normally explicitly acknowledged. In Bourdieu's sense these are the 'structuring structures' (for example the idea of objectivity not as theorised, but as tacitly represented in our whole approach to our practices) [See Appendix A 'Framework Models'].

cognitive capacities of organisms. It is not restricted in principle to this level of explanation, since in general terms it expresses contextual sufficiency, and like 'function' could be applied to any given set of relations. Nevertheless in applying the concept as a theoretical construct in other domains, the basis for its explanatory power requires grounding. This cannot be exactly the same as that which is operative in teleological semantics, since the evolutionary basis for selection is not available in such domains.<sup>31</sup> Two other broad contexts are identified in which de facto selection can take place - learning and social co-ordination - and in effect, they are treated on the same model as basic affordance, in the sense that they are conceived as functions of a set of ecological relations - behaviours (rather than mechanisms) which are conditioned or shaped relative to the contexts in which they are deployed.<sup>32</sup>

### *Holism as Strategy*

In order to make formal use of the affordance concept in these contexts, it would be necessary to define the terms of the relation which are operative in a given context. This task is difficult even in the context of teleological semantics where the parameters are relatively clear, but becomes the more intractable as conceptual, linguistic and social levels are progressively engaged. In fact the terms of the relation at these levels are never unpacked beyond the broad specification associated with meaning contexts. As a result the problem is addressed indirectly in product semantic accounts - rather than attempting to map the relations involved in affordance at a given level, different holistic relations are mapped comparatively. This is reflected in the core use of a product categorisation model based on prototype-semantics, and the general use of attributive semantic mapping, on the assumption that patterns in holistic orderings (and their comparative analysis) are sufficient to reveal relational substructure, to which cognitive processes can be mapped.

However, even in the terms set by the product semantic account, products are not only categorised in terms of their abstractly perceived potentiality, but also through their identity which is primarily articulated in terms of function and social role. They are recognised for what they are as tokens of known types, or as supposed variants of known types, reflecting the embodiment of their social history, rather than the underlying form of cognitive processes. Similarly, translations from semantic attributes to formal features, are largely based on contextualisation in terms of identity (and linguistic attributions

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<sup>31</sup> Product semantic accounts reject sociobiological theories and evolutionary accounts of social behaviour and conceptualisation generally.

<sup>32</sup> In evolutionary terms individuals acquire perceptuo-motor capabilities by inheritance as members of species (where the systems that constitute them are the subject of selection). As individuals the capabilities that they inherit are similarly subject to selection and modification, resulting in characteristic individual patterns of behaviour. Social co-ordination (particularly in the form of convention) is regarded as a special case of behaviour modification, in the form of mutual selection.

centred on identity). Thus although these strategies do identify distinct ways in which products are meaningful, and provide the outline for explanatory models relating to the kind of content implied by achieving meaningfulness, they are pitched entirely at the level of products and their roles, and assimilate the more general mechanisms of cognition and social interaction to this level. The effect of this is to distort the cognitive picture, particularly in respect of the grounding of meaning and the role of affordance.

Product categorisation and projection from attributive terms are descriptively analytic roughly at the ecological level in Krippendorff's scheme. They represent holistic and attributive parsings of the product space. The cognitive organisation and content of models deployed in accomplishing the discriminations that we do make, can in principle be accounted for in terms of the different elements that are involved in the construction of meaning. But if meaning is directly cognised, then these components of meaning-making may not be something of which we are consciously aware in making discriminations, but like the syntactical structure of language, will be descriptive of the way in which the elements interact in the creation of the whole. The product semantic framework effectively assumes that the features of meaning that appear to function collectively at a higher order of product interaction are mirrored in lower levels of cognitive organisation, and further that linguistic expressions functioning holistically relative to the higher levels are sufficient to characterise semantic space generally without the need to break into the sub-structure. There is no warrant for this in the product semantic account

### *Levels and Relations*

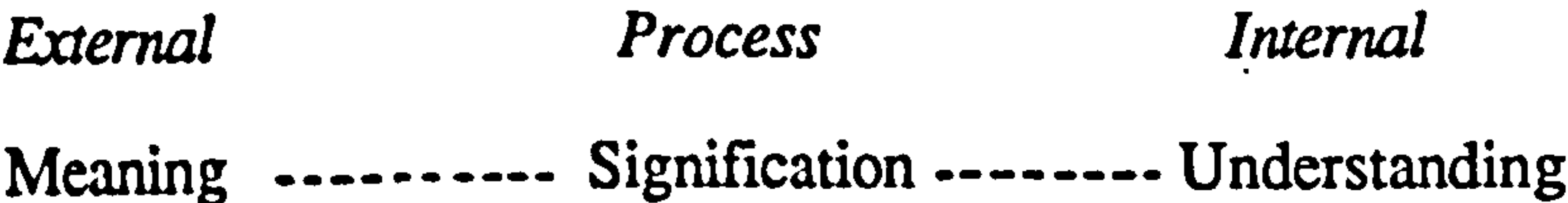
One of the key features in the development of approaches to cognition generally is the recognition that cognitive activity can be characterised relatively autonomously at a number of different levels which are hierarchically organised.<sup>33</sup> Typically this consists in three core levels - a) The knowledge level (or conceptual level), which is broadly equated with the level of intentionality and explanation in terms of actions and goals; b) The symbolic level (or computational level), which is broadly equated with syntactic operations and explanation in terms of symbol processing and transformation operations; c) the biological level (or neurophysiological level) which is broadly equated with actual physical mechanisms and operations, or their analogues, and causal explanation.<sup>34</sup> Product semantics proposes a number of sets of relations in the cognitive characterisation of user-interaction. At its heart the framework is articulated semantically (in terms of a

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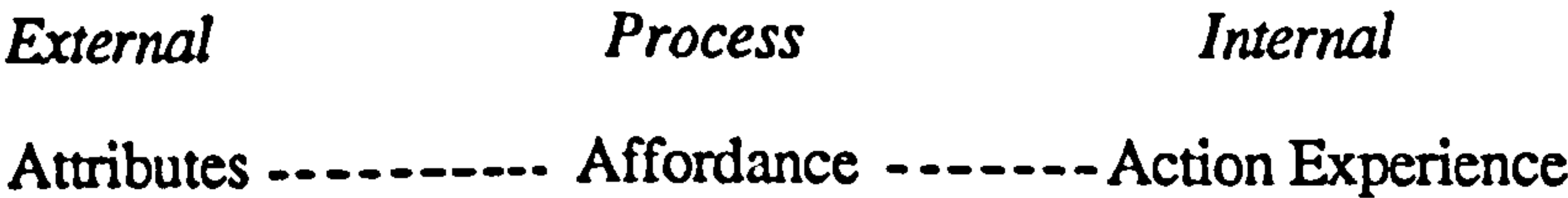
<sup>33</sup> The implication is that the structure and behaviour of a system can be completely specified in a particular sense at a given level, but that the levels supervene on one another hierarchically. (In the case of two adjacent levels, the components of the higher level can be associated with or defined in terms of components of the lower level). [Bell and Newell 1971].

<sup>34</sup> See for example Pylyshyn 1984; Newell 1990.

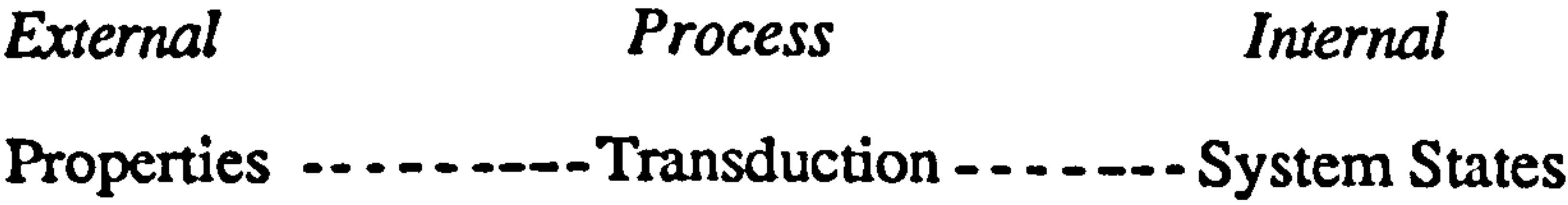
process of signification which is objectified as meaning and internalised as understanding), which might be expressed simply as follows:-



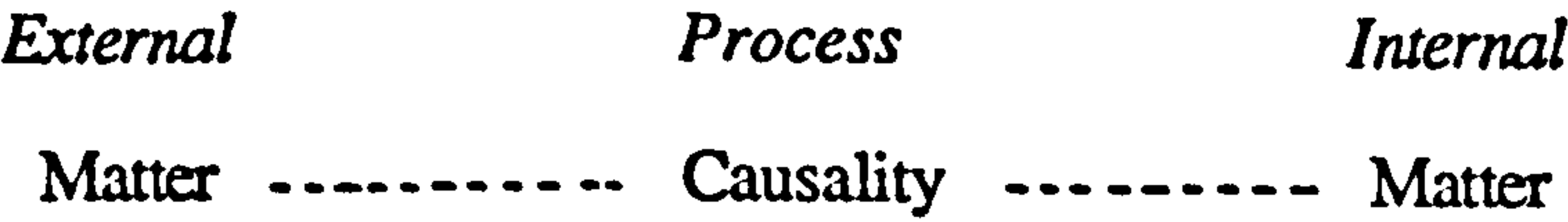
In addition the experiential nature of interaction is articulated in terms of basic affordance (which is ecological in the sense that it encompasses both subject and object as an undifferentiated complex, but which is unpacked in terms of external attribution and internal experience), and which might similarly be expressed :-



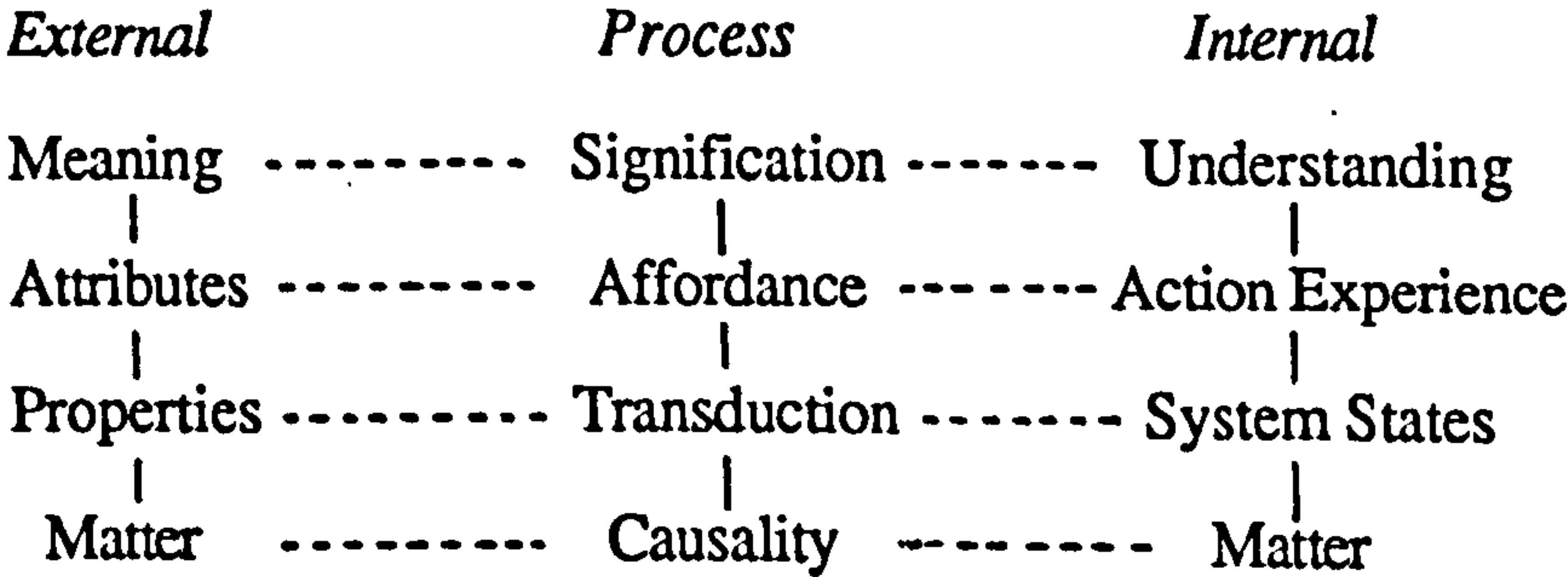
In so far as these relations are instantiated in a representational system, they can be expressed in terms of relations between external properties (values of some parameter in the external world) and states of the system, which might be expressed as:-



Ultimately the description of the interaction reaches a purely physical level :-



Gathering these sets of relations together creates a reductive or constructive hierarchy :-



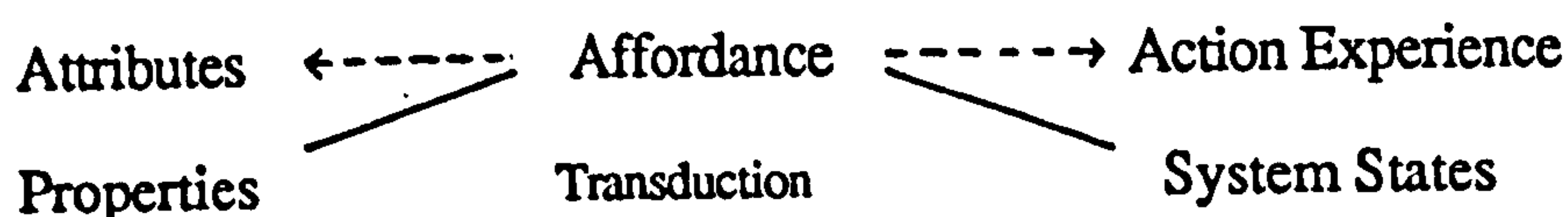
On a physicalist interpretation of the hierarchy of relations, meaning can be explained in terms of attributes, which can in turn be explained in terms of properties, which are ultimately grounded in states of matter.<sup>35</sup> Although the product semantic account does not

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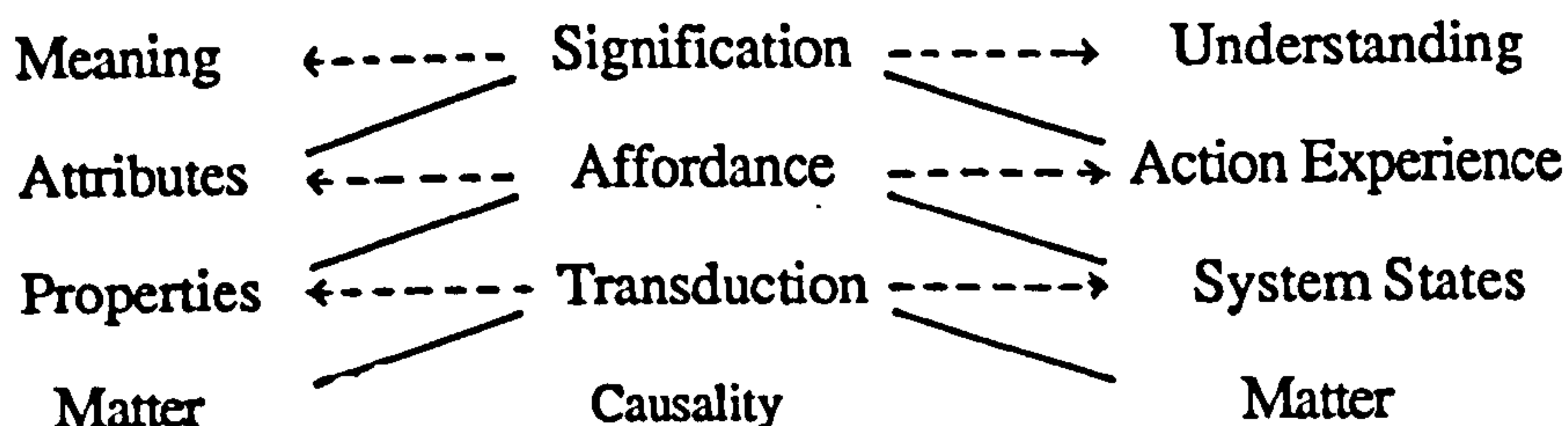
<sup>35</sup> A parallel reductive cascade can be applied to internal states, and to processes.



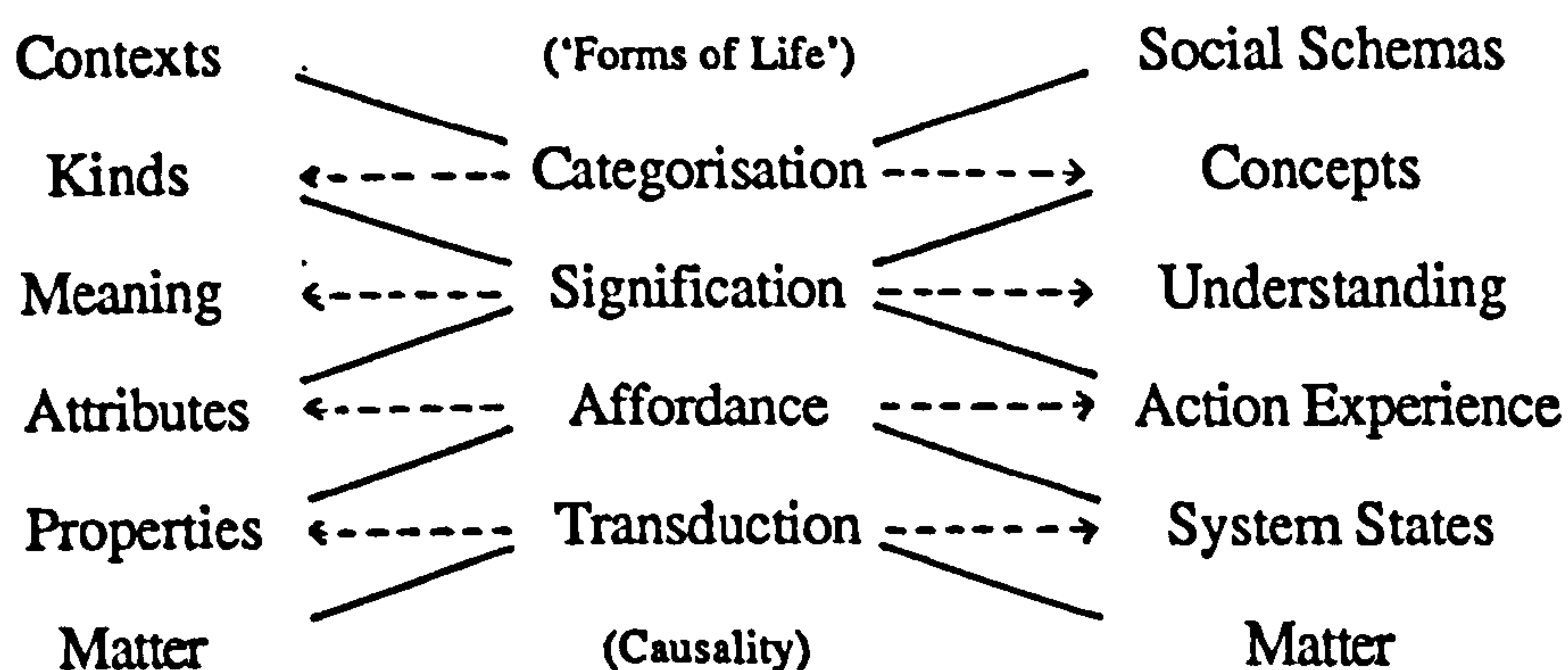
deny that a state or process at one level is instantiated in the form represented at a lower level, a simple reductionist or constructivist interpretation of the hierarchy is rejected. The product semantic account can however be interpreted in terms of the idea that a process at a given level is emergent from the terms of the relation at the next lowest level. Taking one portion of the cascade for example :-



The relation of basic affordance arises from an equilibrium that obtains between properties of the external environment and states of the system (organism), which at the level of the organism as a whole takes the form of a relation between experience and attribution.<sup>36</sup> This idea can be applied to the cascade as a whole :-



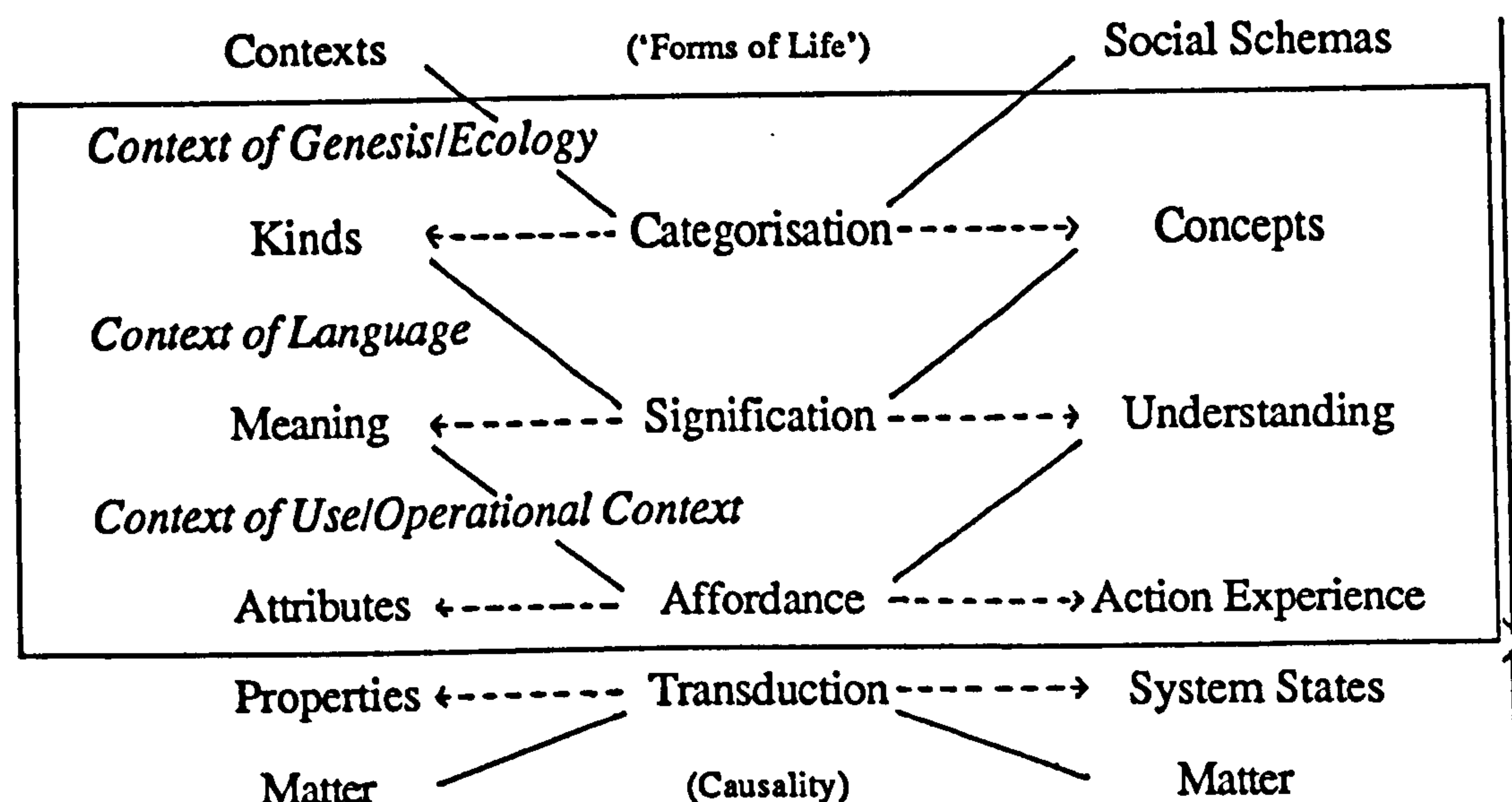
Product semantics also conceives of meaning as deriving from 'higher order' relations, (for example the application of socio-culturally derived conceptual or categorial schemes), which can be represented in the form of an extended hierarchy focused at the level of meaning :-<sup>37</sup>



<sup>36</sup> Non-reductionist hierarchical relations are typically characterised in terms of 'supervenience' and 'subvenience'. These terms are notoriously difficult to define [see for example the 'state of the art' review in Horgan 1993]. The proposed interpretation of product semantic levels and relations, provides the basis for clarifying these important concepts, in terms of relation complexes.

<sup>37</sup> This is represented in the broader context of approaches to cognition, for example, in the socially driven reorientation of cognitive explanation championed in psychological and cognitive science contexts by Bruner, and in a philosophical context by Wettstein [Bruner 1986,1990; Wettstein 1988].

The overall form of the explanatory structure of the framework can be envisaged in terms of the interaction between levels and mediating meaning contexts.



In theoretical terms the framework is driven top-down in terms of socio-culturally derived conceptual schemes which collectively inform the lower levels, although the explanatory scope is restricted to the level of basic affordance. Lower levels are presumed to comprise the substrate of neurophysiological and physical interactions. Similarly, the highest levels fall outside the explanatory structure, and comprise the 'givens' of particular forms of socio-cultural life. Affordance, though having a particular place in the hierarchy (in the form of basic affordance) is applied as the general descriptor for relations conceived holistically at any level.<sup>38</sup>

### *Reconciliation*

The key problem with the theoretical framework is evident in this context. A particular interpretation of 'affordance' is necessary to the framework in order to sustain the continuity between semantic and cognitive orders, and to ground the sense of both 'representation' and 'semantic content' at the level of cognitive mechanisms.<sup>39</sup> This interpretation depends on its relation to evolutionary theory - a relation that is not available

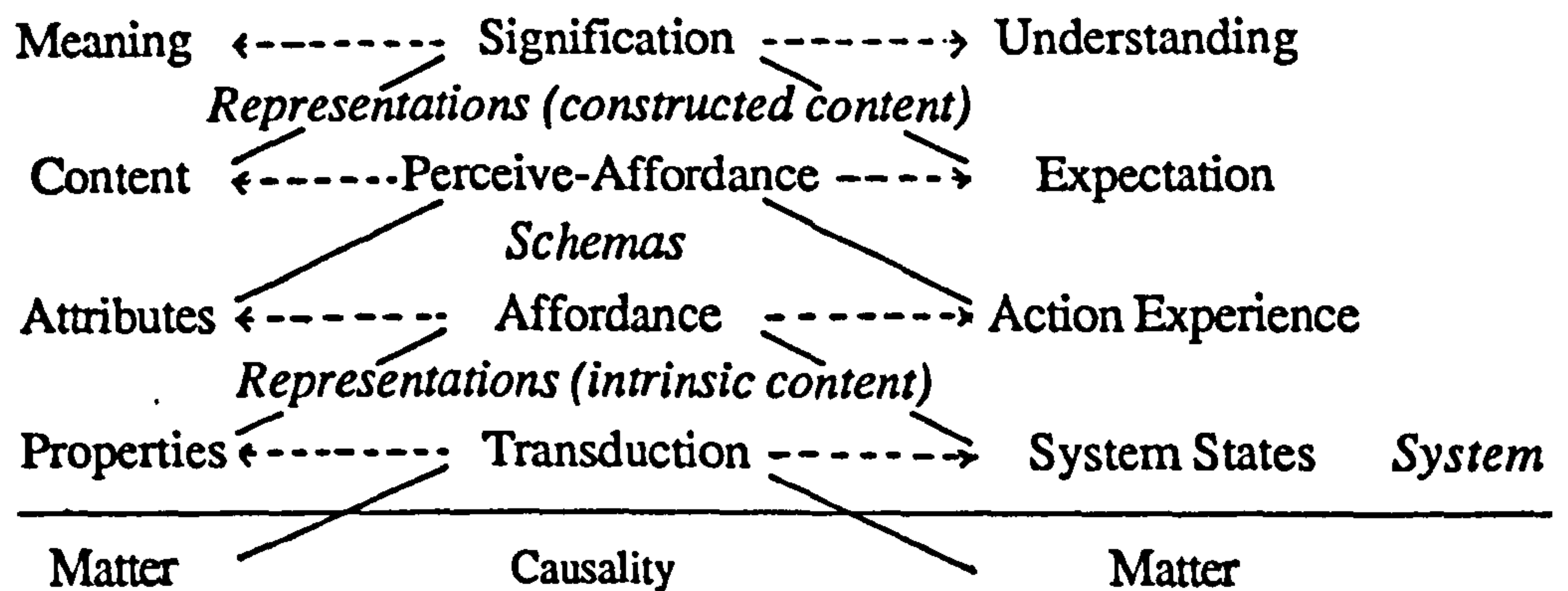
<sup>38</sup> Methodologically, the upshot is that affordance is conceived as articulated in terms of linguistic and categorial models, and the processes of categorisation and linguistic attribution are taken as models for semantic and cognitive processes generally. The detailed implications of the product semantic framework for the implementation of methodologies are explored, by mapping them to a design process model (of a form parallel to that used above, pp 357-358 and footnote 12) in Appendix D, 'A Methodological Implementation'.

<sup>39</sup> See above pp 330-336 and pp 340-341.

at other levels. But no distinct alternative senses of 'affordance' are offered, and instead the crucial issue is elided in the generalisation of affordance within the framework in the context of a top-down conceptually driven scheme. The upshot is a general tendency to transfer properties from higher level constructs to lower level constructs, and the loss of the required sense of the key articulating concept at the lowest level, which vitiates the all-through explanatory ambitions of the framework and leads to inconsistency.<sup>40</sup>

In order to achieve consistency within the framework, it was argued that an alternative interpretation should be applied to certain concepts and relations, and that the bottom-up elements of the process of cognitive reconstruction be reinstated.<sup>41</sup> Two independent sources for grounding meaning were identified, one based on the role of representation in linking affordance with cognitive mechanisms, the other based on the role of signals in behavioural co-ordination. Both can be viewed as bottom-up elements which jointly provide the structure for more complex higher level relations. This can be expressed in terms of two hierarchies of relations :-

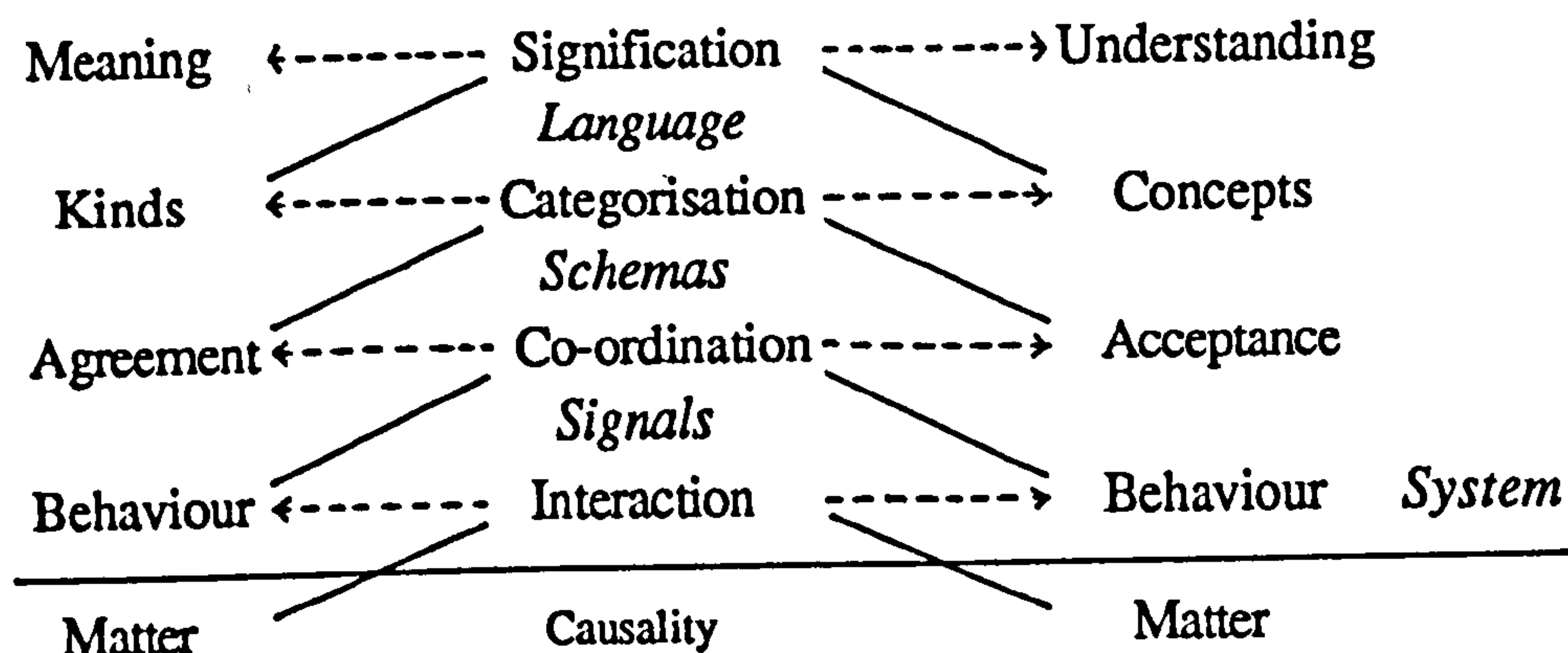
*(1) Affordance Hierarchy*<sup>42</sup>



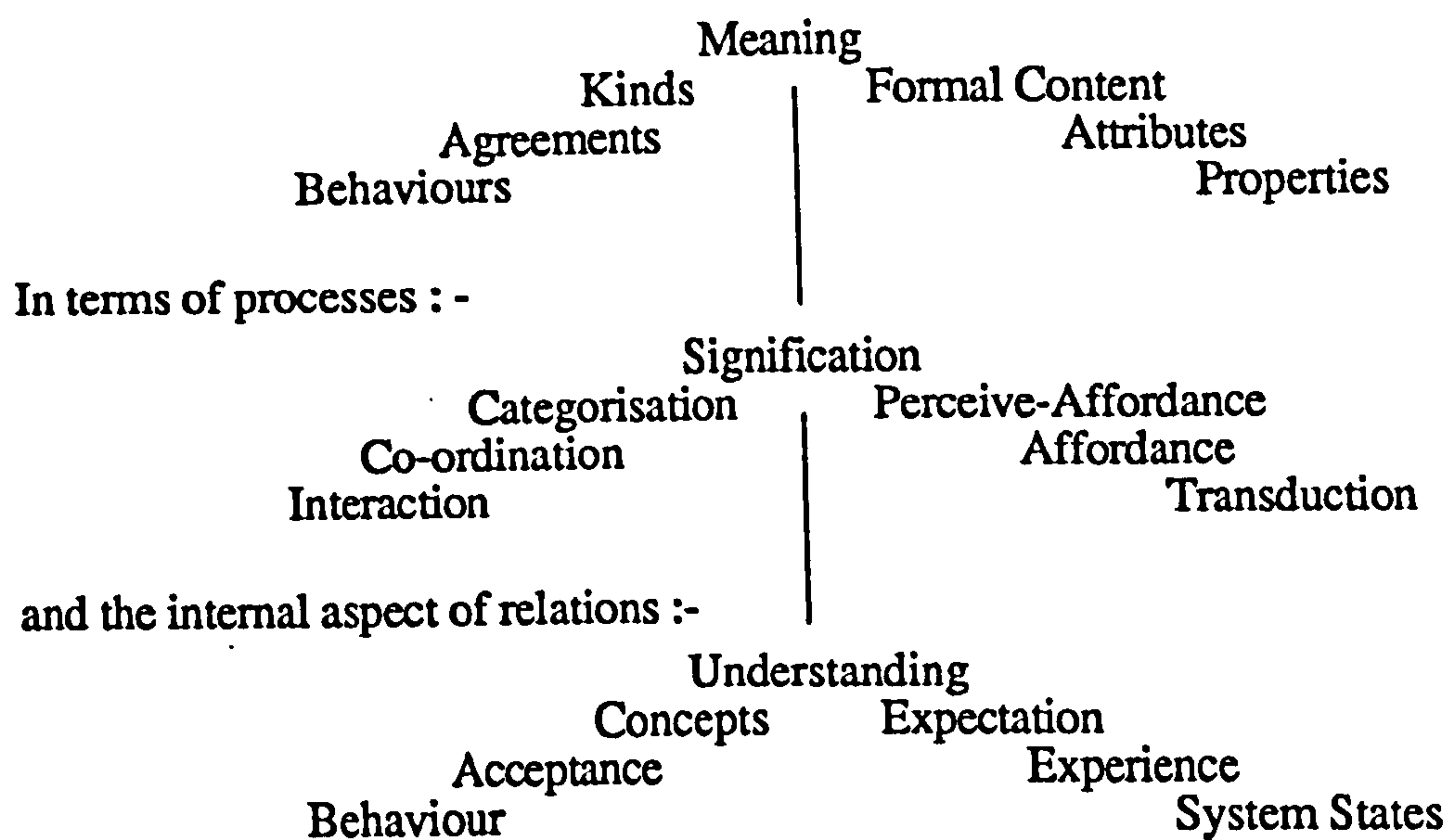
<sup>40</sup> The framework cannot deliver a grounding in two key areas of explanation. Firstly it cannot ground affordance in terms of underlying mechanisms. Secondly it cannot supply an explanation of how conceptual schemes are grounded in social interaction. This is not to deny the conceptual and practical utility of categorisation and attribution as ways of parsing the product space, but only to deny that they offer general models for cognitive processes in the way that product semantic accounts suggest, or that per se they model socio-culturally derived conceptual schemes.

<sup>41</sup> See above Section 10.2 'Conceptual Re-Orientation'.

<sup>42</sup> The affordance hierarchy introduces the perceive-affordance relation, whose position is equivocal in the product semantic account, but which has a clear role in the reconciliatory argument. The scope of the model is restricted to relations operating above the level of systems, which is to say it does not offer an account of what the criteria are for the organisation of matter necessary to constitute a system. Representations mediating system states and affordance are 'intrinsic' in the sense that they are essentially functional isomorphisms [see above pp 329-333], whilst representations at the level of signification and meaning are 'constructed' [see above pp 334-337]. Schemas are relatively stable patterns in the relation between action experiences and perceive-affordances, conforming to the normal range of accepted senses in which they are used in cognitive contexts.

(2) *Co-Ordination Hierarchy*<sup>43</sup>

The relationship between the two hierarchies can be conceived as a three dimensional A-Frame with the level of meaning relations (common to both) as the apex. In terms of the external aspect of relations for example :-



The key difference that this makes theoretically, is that rather than conceiving products (and social structures, languages etc) as entities in terms of which interaction can be directly understood, the suggestion is that they are different kinds of structures inhering in and emergent from the particular implementation of interaction complexes for a given social group. 'Forms of Life' are not taken as given but are constituted in the particular 'local' implementations of different levels of the hierarchy. The lower the level the more likely it will be that for a given species 'forms of life' will be substantially shared. The

<sup>43</sup> The co-ordination hierarchy is similarly restricted to relations operating at systems levels. Signals have a role in the co-ordination of behaviour, and related schemas operate as relatively stable patterns in the behavioural roles of signals. Language is conceived as a higher-level and schematised system of signals.

higher the level, the more likely it will be for 'forms of life' to diverge.<sup>44</sup> Artefacts are complex in terms of meaning relations because they participate in two ways - as signals with social roles in a co-ordination hierarchy, and as objects in an affordance hierarchy.<sup>45</sup> The more so because these are interactive, both at a given level and across levels.

Restructuring the framework in terms of the proposed analysis preserves the product semantic intuition that user-product interaction needs to be understood in terms of meaning complexes and signification, and also in terms of affordance and experiential content, but provides a basis for sustaining this in the context of an all-through explanatory framework. Although product semantics does not propose a design model per se, and it is therefore not feasible to consider a comparative model derived from the reconciliation, some sense of what the implication might be for design can be gained by considering an example such as categorisation. Rather than taking product categorisation as a direct model for a cognitive process, it is viewed as the higher-level outcome of an interaction between processes at a more fundamental level. Understanding user-interaction cognitively involves going down at least one level in the hierarchy (in the first instance), from the level of categorisation to the level of co-ordination (mediated by the schemas that represent the relatively stable structures in terms of which processes are implemented). This involves understanding the nature and structure of different kinds of schemas and their interaction, essentially as contextualised patterns of activity. The model for this might be appropriately drawn from the context of protocol and procedural analysis in the development of expert systems.<sup>46</sup> More generally one could express this by saying that the relevant explanatory level articulating user-interaction is the level which mediates the knowledge level and symbol level in traditional cognitive accounts.

### *Affordance and Product Ecology*

The principal contribution of the product semantic approach, is to suggest the need to understand user-product interaction in terms of the link between semantic and cognitive orders, and the need to view these orders ecologically. The key articulating concept deployed is affordance. At the level of framing design theories the value of affordance is

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<sup>44</sup> To take a biological example, a given species will share a number of fundamental genetic and developmental patterns, which in different contexts will be implemented in different structural forms and behavioural patterns. The explanation of the particular form and behaviours is a function of the interaction between fundamental patterns and context. Bruner's approach to developing socially sensitive models of cognition is based on a parallel reading [Bruner 1986,1990].

<sup>45</sup> In prosaic terms one could say that products are experienced simultaneously as socio-linguistic elements and as objects in the 'natural' environment. In terms of Dipert's intentionalist hierarchy - objects, instruments, tools, artefacts - they can be interpreted as descriptions associated with a given level in the interaction between hierarchies of relations.

<sup>46</sup> Particularly in the sense discussed earlier, where everyday abilities are treated on the model that they are akin to higher order expertise that we all possess [see above pp 346-348].

that it promises to model the relation between form and meaning in terms of the link between syntactic and semantic content in an overall product ecology. But there are in fact two senses in which ecological conceptions are identified in respect of products. On the one hand a product ecology is conceived as the sets of relations that exist between products, which is equivalent to regarding products as species, each occupying a niche in the overall product space. This is essentially the tack taken in the product categorisation model, and is the predominant sense in which affordance is unpacked as an ecological relation in product semantic accounts. On the other hand product ecology is also viewed as embedded in human ecology, which can be interpreted as being equivalent to regarding products as though they were traits or attributes of individuals or groups in human populations.

The latter sense, which remains undeveloped in product semantic accounts, is in many respects the more interesting because of the particular spin it gives to affordance, which is more consonant with the spirit of the product semantic approach, and the reconstructive view of the framework. Products rather than affording outcomes as though they were independent fragments of achievement, afford to the extent that they are assimilable to patterns of human behaviour. Ladders do not afford climbing per se, but only to the extent that they map to patterns of activity with which they are co-ordinated (which is why some things afford better than others). In order to access a level of explanation which can make use of this sense, the suggestion is again that one would need to go below the level of product categorisation (which operates at the level of product placing and significance in the gross social order), to the mediating level of underlying schemas.

### *Tacit Knowledge and Experiential Content*

In addition, one of the major perennial questions relating to the nature and content of theories of design concerns the role of tacit knowledge in our general interaction with the world, and in the activity of designing.<sup>47</sup> The issue is a complex one which subsumes a number of more particular questions relating both to the form and status of knowledge claims and the role of 'background knowledge' in deliberation and action, and to the idea of experiential or embodied 'knowledge' as against propositional knowledge (contained in distinctions such as the contraposition of 'knowing how' with 'knowing that'). Whilst the broad consensus holds to the view that the design process is not fully captured if modelled solely in terms of propositional knowledge,<sup>48</sup> the difficulty associated with unpacking tacit and experiential content, has tended to marginalise their role in accounts of

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<sup>47</sup> See for example Abel 1981; Cross, N 1982; Cross, A 1986; Schon 1988; Goel 1995.

<sup>48</sup> See for example the concluding section of Goel's analysis of the design process from the perspective of cognitive science [Goel 1995].

user interaction and design.<sup>49</sup> The product semantic framework acknowledges the importance of these elements of the content of our engagement with the world, and attempts to address them through the idea of complexes of interaction conceived in terms of affordance, meaning and context.<sup>50</sup> However, in emphasising the linguistic and conceptual elements of the framework and in conceiving a socially driven top-down view of its structure, this crucial aspect of experience in interaction is lost. The proposed reconciliation acknowledges that expectations and the recognition of qualities are not constructed from a pure material rationality, but rather arrive wrapped up in the affective context of their representation.<sup>51</sup>

### *User Interaction and Design*

The product semantic account is based on the idea that in order to comprehend user-interaction, an explanatory framework is required which reaches down to the 'mechanics' of individual cognition. In one sense this is correct - it ought to be possible to account for the observed content of interactions ultimately in terms of deep cognitive explanations. However, it does not follow that knowledge of lower level cognitive mechanics can be applied constructively and synthetically in order to infer content at higher levels.<sup>52</sup> The assumption in product semantics is that constructive inference is in-principle possible and that higher level processes and outcomes are sufficient as structural models for lower level processes. The reconstructive analysis of concepts and their relations in the framework suggests that this is incorrect, and leads to inconsistency if the distinctions between explanatory levels are blurred.

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<sup>49</sup> The major developments in this area have taken the form of substantial theoretical and empirical attention to participant observation and protocol analysis [Bessant 1979; Bucciarelli 1988; Eckersley 1988; Cross and Cross 1995; Visser 1995; Lloyd et al 1995; Akin and Lin 1995; Dorst and Dijkhuis 1995; Galle and Kovacs 1996; Margolin 1997; Gero and McNeill 1998], the role of precedents [Clark and Pause 1985; Oxman 1990, 1994] and cognitive styles [Cross A 1984, 1986; Ward 1984; Cross N 1985; Tovey 1984, 1986, 1992, 1997]. The majority of these studies concern the design activity rather than the user, and the majority gravitate to formal expression in traditional propositional and inferential modes.

<sup>50</sup> At the methodological level this is reflected in the perceived need to model user understanding in terms which might be described as ethnomethodologically informed extensions of a cognitively centred 'ergonomics'.

<sup>51</sup> The role of objects in our lives is complex, but at least part of what they provide is a location for the embodiment of feelings and associations, to the extent that a parallel to the concept of empathy has been proposed as the core principle for comprehending the user-product relation. [Crozier 1994; Crozier and Greenhalgh 1992a, 1992b]. In the proposed reconciliation of the framework, the role of affordance is in part characterised by affective representation as an essential element of intrinsic semantic content. At higher levels, affective content comprises a part of constructed representational content, through the association of intrinsic content with significatory context.

<sup>52</sup> The idea of 'emergence' is a commonplace of prospectively reductive and constructive hierarchies, which demonstrates this. Although, given the idea of a biological entity it is possible to explain its behaviour in say chemical terms, the entity cannot be inferred from the chemistry. Although it may be necessary to demonstrate theoretical and explanatory continuity between levels in order to establish the explanatory validity of a given level, explanations need to be sought at the level closest to that requiring explanation.

The higher level models in the product semantic account (eg product categorisation) relate to a conception of product ecology which treats them on the model of species in an independent ecological order with which human populations interact, placing the artificial environment on a par with the natural environment, and inviting the application of cognitive models of natural categorisation to the artefactual order. Although parsing the product space is a useful tool, the relation it bears to cognitive accounts of interaction are more remote than this strategy suggests, for two principal reasons. Firstly, the ecology of products is distinct from the natural order in the sense that products are 'placed'. Product categorisation needs to take account of the fact that the product field is pre-categorised intentionally - it is a reflection of the outcome of a complex of processes at a number of levels. Secondly, cognition itself is active in the sense that it is as much shaped in relations held with 'placings' as with a received order.<sup>53</sup>

The implications of the reconciliatory arguments are that the second conception of product ecology noted above - that products can be conceived as traits or attributes - is necessary to the framework. The idea of product fields constituting a relatively independent order is augmented with the idea of behavioural fields, which transposed to a cognitive context are implemented in the form of a variety of schema models. From a theoretical point of view this would locate user-interaction in terms of both a cultural model (in the form of cultural outcomes, mapped to social roles) closely linked with identity and tracked in categorial and attributive terms, and in terms of an individual cognitive model centred on content and expressed in terms of behavioural schemas (physical, intellectual and affective).

One way to view this is by returning to the core model of transparency and opacity discussed earlier.<sup>54</sup> Products as engaged are in a dynamic state between complete transparency and complete opacity (between absorption as a personal attribute, and absorption as an environmental attribute). Where the balance is such that the product is relatively transparent, the relevant explanatory model will centre on individual cognition and behavioural schemas. Where the balance is shifted towards opacity, the key question is identity, and the dominant explanatory model will locate the product categorially and in terms of linguistic attribution. Clearly this is a complex multi-dimensional dynamic situation in which the product might be relatively transparent in some respects at some times and relatively opaque at other times, and it would be no trivial matter to translate the theoretical picture methodologically.

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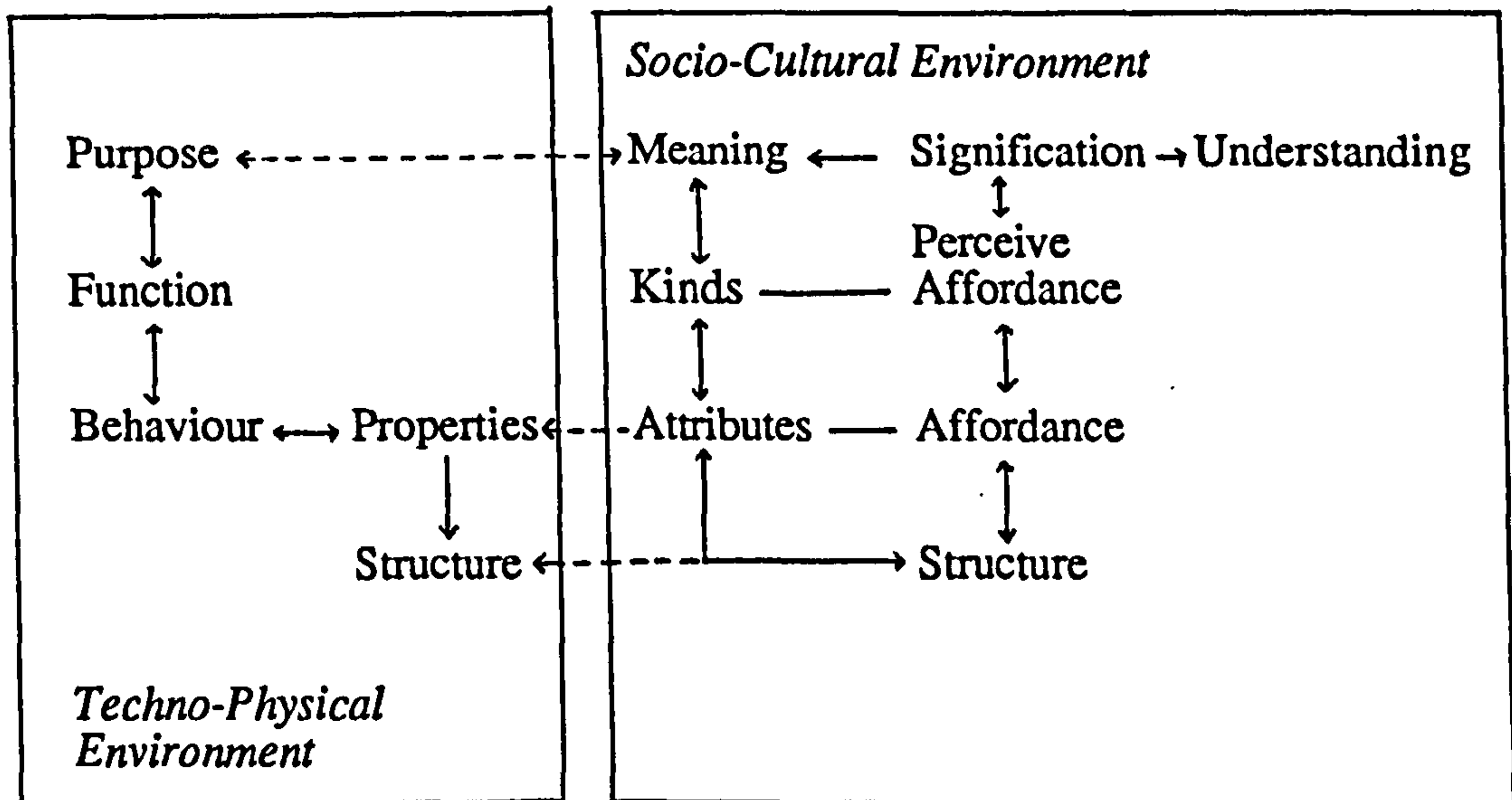
<sup>53</sup> The importance of this for cognition generally has been emphasised particularly by Clark [see for example the extended consideration of case studies drawn from cognition, artificial intelligence and robotics in Clark 1997]. The idea is roughly that we shape the nature of cognition in creating the contexts for cognitive activity - there is a mutual accommodation between the organisation of our personal environments in order to facilitate actions of certain kinds, and the shaping of actions in the organisations we create.

<sup>54</sup> See pp 190-191 and 306-307 above.



Products can be viewed as an external aspect of cognitive functioning, either in the sense of 'wide computationalism' where aspects of the external environment are treated as parts of the system for the purposes of cognitive processing, or in the sense that they represent parts of the cognitive system that are not possessed by an individual.<sup>55</sup>

There appear to be no good grounds in the product semantic account for excising function from design theory. It is clearly the case that function is necessary to the articulation of the product categorisation model, and necessary to the sub-structure of affordance in teleological semantic accounts. In addition product semantic approaches which most closely approach a methodological implementation, take the tack of mapping a semantic model to a function-centred design model.<sup>56</sup> The principal product semantic objection to function in the 'prevailing paradigm' is the role that it plays in determining the structure of semantic relations, but it is not necessary to excise function as a mode of analysis in the techno-physical domain in order to assert the idea of 'perspective' and the independence of semantic structure in the socio-cultural domain. In terms of the simple domain models used earlier to describe the outline position of the prevailing paradigm and the product semantic account, the reconstructive model might be summarised as :-



<sup>55</sup> In the form of wide content or wide computationalism [see above pp 325-328 and Wilson 1994; Walsh 1998]. An alternative reading would be to argue for a parallelism between the concept of 'external memory field' as applied in the case of written language and pictorial records by Donald, with products as an embodiment of individual expression in terms of cultural history [Donald 1991]. In abstract terms this can be elevated to the theoretical proposal that products constitute a literal equivalent. The assumption that this is the case underlies theory in archaeology and the history of material culture [see for example Kubler 1962].

<sup>56</sup> See below Appendix D 'A Methodological Implementation', particularly in respect of Butter's model and the synthetic implementation of Vihma's analysis.

### **11.3 Summary - Design Theory and Methodology**

- a) The core problematic in design is located in the sphere of consumption/reception rather than in the sphere of production.**
- b) Product semantics is not a model of design, but a semantic characterisation of user-product interaction which informs the design process.**
- c) The inferred form of the design process in product semantics differs from the function-centred paradigm in locating the model for semantic structure primarily in the socio-cultural rather than in the techno-physical domain.**
- d) The semantic structure of user interaction is conceived in terms of the conceptual role of 'meaning', 'perceive-affordance' and 'affordance' (and their relations), in explaining the expectations engendered for the user in product encounters. These are grounded in terms of identity and content. Content is given priority in the product semantic account, and affordance conceived as articulating meaning with form.**
- e) Affordance (in the form of direct perception and basic affordance) is conceived as a ground level relation, which provides the foundation for culturally and conceptually relative higher level meaning relations. Nevertheless the structure of basic affordance is also conceived as conceptually organised in terms of higher level meaning relations.**
- f) The terms of the affordance relation (which differ at different levels) are not established for any given level beyond the broad identification of meaning contexts. Holism is therefore adopted as a strategy, driving a top-down conception of explanatory structure.**
- g) A reductive interpretation of explanatory levels within the framework is rejected. Instead, the relationship between levels in the product semantic account can be interpreted in terms of the idea of supervenience of levels, unpacked as an emergent cascade.**
- h) Taken together, the top-down conception of explanatory structure and the supervenience of levels, leads to the generalisation of affordance in terms of contextual sufficiency and the transposition of models for higher level explanation to lower levels, leading to inconsistency.**
- i) The particular interpretation of affordance necessary to ground the ideas of 'representation' and 'semantic content' at the level of cognitive mechanisms, and to sustain continuity between semantic and cognitive orders, is also lost.**

- j) The inconsistencies can be addressed, and the crucial role of basic affordance in cognitive explanation restored, if the two distinct sources of meaning relations identified in the conceptual re-orientation of the framework are used to restructure the explanatory hierarchy.
- k) The resulting framework conceives meaning relations as the higher level constructs arising from the interaction between two parallel hierarchies of relations, based respectively on affordance and co-ordination.
- l) Products can be viewed as elements in the interaction between these hierarchies, and in this sense on a par with structures of other kinds (such as social structures and roles, languages and codes). This view of the nature and conceptual location of products, conceives product ecology in terms of traits or attributes of human populations (social groups), in addition to the product semantic conception of product ecology as a relatively independent order of artefacts (comparable with the natural order).
- m) Both ecological conceptions are important, since the core model conceives products in terms of a dynamic balance between transparency and opacity. The theoretical and methodological bias in product semantics towards an independent order (product fields), is balanced in the conceptual re-orientation of the framework in terms of the idea of 'behavioural fields' in which products participate, and which can be approached theoretically and methodologically in terms of the deployment of different schema models in respect of product encounters.
- n) There are no good grounds for excising 'function' or function-centred models from design theory, or for replacing them tout court with meaning models. The assertion of the independence of semantic structure in the socio-cultural domain from the structure of the techno-physical domain does not preclude the utility of the function-relation in structuring the latter. The product semantic framework can be modelled broadly in terms of the internal structure of the socio-cultural domain and the elements through which it articulates with the techno-physical domain.

## 11.4 Semantic Theory and Cognition

The arguments developed in Section 9.1 - 9.5 suggest that key elements of the framework cannot be reconciled within an overall frame of reference conceived in terms of the traditional approaches to meaning and representation adverted to in the product semantic account. Given that this is the case there are essentially two alternatives.

The first would be to conclude that although individual elements make sense in the separate contexts in which they are developed, it is their collective deployment in the framework that leads to inconsistency. In section 10.1 - 10.5, it was argued that achieving consistency within the product semantic framework, on its own terms, particularly in respect of the relationship between semantic and cognitive aspects of explanation, implies the need for a clear distinction in explanatory orders, and different senses of 'affordance' 'meaning' and 'representation' related to those orders. However even if this interpretation were accepted, the resulting reconciliation would not align with the approaches to semantic theory and cognition adverted to in the product semantic account. One would therefore either have to concur with the above conclusion that the framework is inconsistent, or to adopt the alternative stance.

The second possibility would be to assert that having achieved a measure of internal consistency, the lack of fit with semantic and cognitive theory (writ large) rests in the inadequacy of traditional accounts of meaning and representation, rather than with the product semantic framework. The justification for pursuing this alternative is that it is generally acknowledged that traditional accounts fall short, particularly in respect of their capacity to characterise experiential content, and also in maintaining convincing continuity between semantic and cognitive orders of explanation.

The present section considers an approach to semantic theory and cognition based on the interpretation of the product semantic account proposed in Section 10.1-10.5, which argues for distinct explanatory orders and associated senses of 'representation'. This is undertaken in the broader context of the problems associated with traditional models, and the development of alternatives. The issue can be restated in terms of the more general question of whether it is possible to approach the ideas of embodiment and experiential knowledge given the common assumptions of semantics, and if not whether it is possible to generate a viable alternative, which is consonant with the product semantic stance. In short, what are the possible implications of product semantics for approaches to semantic theory and cognition ?

### *Post-Fregean Semantics*

The dominant philosophical model underlying most recent theories of mind and mental representation have followed Frege in regarding language as the model for the articulation of thought, and in giving priority to thought rather than experience, which is to say - assigning explanatory priority to a theory of representation in thought over a theory of representation in experience.<sup>1</sup> (The relevant idea of priority can be interpreted in terms of analytical priority - that T is prior to E, if and only if, the concept T can be explained without the concept E, and E cannot be explained without the concept T.) This is essentially the position reached if the product semantic framework as a whole is articulated solely in terms of the top-down elements of explanation.

The upshot of the priority of thought over experience is that representation in the case of embodied practice is explained in terms of the prior criteria for representation in thought, namely the framework of reference, satisfaction conditions and truth, which are established independently of embodied experiential practice. But if they are independent, it is difficult to give any sense to the idea of practice as being representational - as having semantic content - except through a metaphorical parallel with the external referential norms which give substance to the idea of the intentionality of thought or language.

The general strategy in attempting to ground representational theory in experience has in fact taken the form of accounts which start either with presuppositions regarding the concept of mind and mental experience in terms of which the world could be explained, or presuppositions about the world which are used to articulate an explanation of mind and mental experience. Frege's contribution to the logic of the situation was to show that making sense of semantic and representational functions requires the systematic application of an external criterion in respect of the mappings between representations and things represented. The essence of the position, which has strongly influenced the general thrust of semantic theories, is that it is a condition for the possibility of representation that there be a sharp distinction between the representation and the represented. This separation is embodied in Frege's scheme in the form of the sense/reference distinction, which presupposes both world and mind - world as the domain of reference (the objects of our thought and language), and mind as the domain of sense (the manner in which the objects of thought and language are cognitively apprehended).

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<sup>1</sup> Frege 'Thoughts' in Frege 1977; Dummett 1973. The principal exception is the empiricist/positivist approach of the Vienna School, and Carnap in particular [Carnap 1967]. However in most views this position is considered to have foundered on the assumptions associated with what is given in perception, and the severing of the relation between representation and experiential content [See for example Pettit and McDowell 1986].

But in order to ground representational theory in experience, rather than simply accounting for experience in terms of the various presuppositions needed to articulate thought and language, it is necessary to show that it is possible for subject/object or sense/reference distinctions to arise in experience, since these are not inherent in the idea of experience. In other words it involves rejecting the sharp edges of Frege's scheme.

Roughly speaking, this turns on the question of the relationship between content and concept. The prevailing model works on the idea that the possibility of mental states having content is dependent on the possession of concepts. Whatever spin is given to the way in which the idea of 'concept' is actually unpacked, its underlying function is to contain the idea of generality which is a necessary consequence of compositionality. In order for a language (or a language of thought) to work, there needs to be a systematic relation between the value of complex expressions and the values of the simpler expressions or elements of which they are composed.<sup>2</sup> The underlying idea of a 'concept' (however it is construed) is that it determines whatever it is that enables substitution and compositionality to take place.

The prevalent view in the philosophy of mind is that representation is determined by conceptual capacity. The ways in which the world can be represented (or indeed on some views the ways in which the world can be) is dependent upon the possession of concepts which are required to ground particular forms of representation. Mental content can be ascribed to an individual to the extent that it has a conceptual structure capable of systematically sustaining some form of representation. This general view has two important consequences that bear on the question of experiential content. In the first place, it asserts that there can be no representation or content without concepts. Secondly, it bears on the question of the distinction between sensation and intentional content such as belief. Both reinforce the separation of bodily experience from thought, and the priority of thought over experience.

This is the general problem faced by the product semantic framework in reconciling its semantic and cognitive components. If the commitment to an experientially centred semantic account is to be cognitively grounded, then the relevant sense of representation and content cannot be based on conceptual priority, since this would undermine the explanatory role of representation. On the other hand a constructive and associative sense of representation requires grounding in a conceptual scheme. In order to achieve

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<sup>2</sup> In the case of predication, for example, understanding the truth conditions for the application of a predicate to a proper name consists in an independent understanding of the singular term and the predicate and the substitution of arbitrary objects as satisfying the predicate. Understanding 'Richard is tired' is systematically related to understanding 'Eric is tired', and to 'Richard is happy'. The necessary generality required for the system to work, is tied to the independent understanding of the terms of the predication, coupled with an understanding of the conditions for the possibility of their substitution.

coherence and continuity within the framework, the two distinct senses of representation proposed (representation based on intrinsic semantic content, and representation as a constructive process which creates semantic content) need to be operative.

The more general challenge to the received view arises from two kinds of observation which are consonant with the product semantic approach. The first is that it is by no means clear that the richness of experience is fully captured by the possession of concepts and their expression in intentional and propositional terms - the content of experience is far more replete and dense<sup>3</sup> than the conceptual content required for the articulation of intentionality. This would mean either that there are experiential elements that have no role in representation, or that representation and mental content can be construed nonconceptually. The intuitively more appealing latter alternative<sup>4</sup> is supported by the second kind of observation, which points to cases where intentionality and experience diverge. In the case of optical illusions for example, knowledge that one is experiencing an illusion does not necessarily make the illusion disappear. This suggests, in conformity with the arguments for reconciliation within the framework, that the distinction between experiential and intentional elements is not that one is a representation based upon the other (which is non-representational), but rather that it is a distinction between kinds or senses of representation.

The general contention is that whilst it is true that some cognitive elements such as perceptual beliefs are constrained by the conceptual capacities of agents, there may be kinds of cognitive state that are representational (that have content) but which do not require possession of the concepts needed to characterise their content. In other words, there may in-principle be states with non-conceptual content.<sup>5</sup> In practice it is argued that the idea of non-conceptual content is necessary for the explanation of perceptual experience, and for the explanation of sub-personal computational states in computational theories of mind.<sup>6</sup>

### *Non-Conceptual Content*

In order to pursue the possibility of non-conceptual content it is necessary to develop convincing conditions for having content which are not dependent on the priority of

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<sup>3</sup> In Goodman's sense [See Goodman 1976; Goel 1995; and Section 7.5, pp 242-43, above].

<sup>4</sup> More appealing because it is hard to accept at face value the idea that large and significant areas of experience are epiphenomenal, and have no place in explanatory and evolutionary account.

<sup>5</sup> The idea of non-conceptual content was introduced by Evans in the context of an exploration of post-Fregean concepts of reference [Evans 1982].

<sup>6</sup> The impetus for this view is largely derived from Marr's influential work relating to processing in the case of visual perception [Marr 1982] which is articulated in terms of stages of processing which are argued to have representational content, but not all of which are accessible.

concept possession. Bermudez has offered a set of four criteria which need to be satisfied before states can be properly described as representational.<sup>7</sup>

- (1) They should serve to explain behaviour in situations where the connections between sensory input and behavioural output cannot be plotted in a lawlike manner.
- (2) They should admit of cognitive integration.
- (3) They should be compositionally structured in such a way that their elements can be constituents of other representational states.
- (4) They should permit the possibility of misrepresentation.<sup>8</sup>

These criteria are satisfied by the paradigmatically representational concept dependent intentional states of folk psychology, but do not rely on the priority of concepts. They are also met by the conditions for representation expressed in terms of intrinsic semantic content in the bottom-up element of the product semantic account. Essentially the idea is that representational states mediate between sensory input and behavioural output and are theoretically required to explain the relationship. But not all input-output relations are in need of an explanatory intermediate, since some are the direct result of an invariant relation between the two, and need not appeal to the idea of how things are represented as being. In such cases, states of the organism may be ascribed values but not content. A parallel consideration concerns the possibility of misrepresentation. Even in cases where it might be natural to talk of states having content, for example, information content, it is inappropriate to consider such states as being representational if the possibility of misrepresentation is ruled out.<sup>9</sup> Although representational states have cognitive functions in input-output mediation, it is clear that per se they are insufficient to explain behaviour, and need to be systematically coupled with other cognitive states such as motivational states, in behavioural explanation. In addition, in order to obtain continuity in representation through time, and flexibility in behaviour relative to environmental change and previous experience, some measure of generality across representational states is necessary, which is expressed here in terms of structural compositionality.<sup>10</sup>

The application of the idea and associated criteria in the cases of perceptual experience and sub-personal computational states suggests that there is a meaningful category of states having non-conceptual content. In addition, the concept-involving states form part of a larger class of states having content, together with the non-conceptual representational states. This opens up the possibility of reconsidering the nature and genesis of concepts and the continuity between propositional and experiential (embodied) knowledge.

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<sup>7</sup> Bermudez 1995.

<sup>8</sup> Bermudez 1995 pp 351-352

<sup>9</sup> Cummins 1989, 1996; Woodfield 1986.

<sup>10</sup> The basis for the criteria are presented here in outline only. For a full discussion of the development of the criteria, with examples, see Bermudez 1995 pp 344-352.



### *Abilities to Act - Affordances*

The idea of non-conceptual content is not sufficient, but it does begin to breach the necessary connection between representation and conceptual structure implied by post-Fregean semantics. Given that content consists in some form of representation of the world in thought or experience, most semantic theories account for differences in content in terms of the application of concepts whose veridicality is established via the domain of reference. Content is equated with propositional content, and differentiation and evaluation accomplished through the formality of the relationship with reference and truth. The alternative consists in adverting to the cognitive significance of encounters with the world in terms of abilities to act - affordances.

Organisms possess a range of abilities to act on, and in relation to, the environment and changes in the environment, which although not present to the subject in terms of the referential aspect of content, are nonetheless available in the form of experience-based knowing-how. Content can be specified by reference to abilities because its cognitive significance can be expressed in terms of the experiential availability of such abilities, which are embodied in the continuing relation between the organism and its environment.<sup>11</sup> However it will also be apparent that specifying content in this way disengages the specification of content from the specification of reference or truth. On the face of it this is not a promising move since it seems to undercut the idea of both a subject and an object. The kind of content that can be specified in terms of embodiment can only be of the form of an experiential awareness of how-to-act-relative-to-a-state-of-the-environment, but without any purchase on the idea of something independent constituting an object of the experience, or the perspective of a subject.<sup>12</sup>

The problem in seeking to establish a basis for cognition in experience, rather than through some form of 'language of thought' hypothesis, is to explain how the sense/reference or subject/object distinction can arise from the bare content of undifferentiated experience, and further to show how this establishes a route through to the complex conceptual structure that is evident in human cognition and action. This involves several elements, which have been the subject of independent work by a number

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<sup>11</sup> Essentially the concept of 'affordance'.

<sup>12</sup> Strawson, for example, argues that criteria for objectivity are co-extensive with criteria for non-solipsistic consciousness, which are in turn dependent on the possibility of re-identifiable particulars. This is taken to be equivalent to the logical possibility of the independence of states of the world and states of the person [Strawson 1959]. The general point in the case of experiential knowledge is parallel to the Wittgensteinian arguments against the possibility of a private language. Re-identifiable particulars are only meaningful in a public context, which provide a basis for rule-following and identity conditions which are absent in the bare context of the experience of an individual in the world.

of authors.<sup>13</sup> Nevertheless the essential point relates to ways in which what has been termed 'metaphysical distance between subject and object' might be achieved.<sup>14</sup>

The general approach, which is parallel to the role of misrepresentation in giving an intelligible account of representation,<sup>15</sup> is that objectivity of content is related to the possibility of the incorrectness of content, which in turn depends on the referent of the content being in principle a public object - available to any subjective point of view. But this needs to take place in a context where the conditions for metaphysical distance are not evident - where criteria dependent on the domain of reference are absent. In language, the application of criteria relating to the domain of reference depends on subject/predicate structure. However it is possible to imagine a language in which subject/predicate structure is taken to be semantically complex rather than simple. Strawson suggests a case where a more primitive substructure of the predicative elements of language can be posited and expressed in the form of a more elementary 'language'. The 'feature-placing' language that he explores takes as its terms, the residual content of terms of ordinary language from which identification (and re-identification) conditions are eliminated.<sup>16</sup> The idea derives from exploring feature-placing sentences of ordinary language such as 'it is raining' or 'raineth' which do not serve to characterise particulars, but which act as experiential indicatives relative to substance terms. The character of such sentences is interesting both because the substance terms do not serve to attach a property to a particular, and because they are not sortal terms which can divide their reference, except through the addition of criteria of identity and distinctness. The semantics of feature-placing is restricted to incidence indication, and can only cope with instances and particulars if the language is enriched with concepts which divide their reference.<sup>17</sup>

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<sup>13</sup> The idea of 'non-conceptual content' and the general possibility of strategies based on it for dealing with semantic issues, particularly relating to reference, originates in the work of Evans [Evans 1982]. Explication of non-conceptual content and the development of related criteria for content and representation have been pursued particularly by Peacocke and by Bermudez. [Peacocke 1992; Bermudez 1995]. The more general question of the possibility of a symmetric metaphysics which is compatible with an asymmetric representational theory giving priority to experience over thought, has been pursued by Cussins, who draws particularly on the work of Evans and Strawson in developing a theory [Cussins 1992].

<sup>14</sup> Cussins 1992, p 660. The idea that 'metaphysical distance' (for example the separation between subject and object) is not given but is achieved is not new, and forms the core of a number of phenomenological and hermeneutical approaches [Heidegger 1967; Gadamer 1975; Merleau-Ponty 1962, 1963]. In relation to the idea of embodiedness in cognition and artificial intelligence [Varela, Thompson and Rosch 1991; Clark 1997]. The most developed overall philosophical position which is based on the idea is represented in Smith's proposal for a new metaphysics which stems from a critique of assumptions about the nature of computation, intentionality, and the philosophical notion of an individual and a particular [Smith 1996].

<sup>15</sup> Cummins 1996

<sup>16</sup> Strawson 1971, 1959.

<sup>17</sup> Sortal terms do more than feature placing terms, since they introduce sortal properties or kinds as identity conditions. This is akin to providing a substructure to feature space in the form of boundary conditions which allow for divided reference. The term 'cat' partitions feature space into bounded regions defined by cat identity conditions. This makes it possible to make sense of counting cats in a way that is not available to an experiential feature placing term such as 'wetness', unless supplemented by additions such as 'here' and 'now'.

### *Cognition based in Experience*

Given the background of post-Fregean semantics and the material that might bear on an alternative based in experience, we can consider one example of a proposed strategy.<sup>18</sup> Cussins in his discussion of Strawson's feature-placing language, notes that ascending to the semantics of subject/predicate structure, requires some means of establishing boundary conditions for the feature. It is this that supports the systematic application of correctness criteria and the possibility of compositionality.<sup>19</sup> In applying this to the idea of giving priority to representation in experience over representation in thought, Cussins is able to re-formulate the general problem in different terms. The strategy of specifying content non-conceptually through the idea of a domain of embodiment can be assimilated to the idea of a representational medium based on 'feature-placing'. If this is taken as the basis for a general model of cognition, then the question can be re-framed in terms of how non-conceptual representation based on feature-placing can acquire the structure to support subject/object or sense/reference distinctions, without their presupposition.

Cussins strategy is to provide an indirect analysis of the idea of generality, which as we have seen, underlies such distinctions. His conclusion is that generality is not a one-dimensional property but (at least) a two-dimensional property which he maps in terms of plotting a 'Perspective Dependence Ratio' against a 'Stabilisation' measure. Generality, in the sense required to support compositionality, occupies a small region of the semantic space where both the PD Ratio and Stabilisation are high.

Perspective dependence, which is explored and presented through an analogy with navigating an environment, represents the degree of competence of an 'organism' to locate a goal, as a proportion of its whole territory. If the whole territory falls within the organism's zone of competence then the PD ratio is 1 (the organism in this environment is perspective independent); if the zone of competence encompasses only a small region of the territory surrounding the goal, then the PD ratio approaches 0 (the organism is highly perspective dependent). Intermediate positions represent cases with a varying degree of overlap between regions having landmarks, which together extend the zone of competence to encompass the goal.

If this basic metric is applied in the case of an environmental feature domain it will hold no intrinsic distinction between object, subject, location and property, but will only capture feature placings ecologically - as a composite of the domain of embodiment and the environment. But since there is no subject as yet, the abilities of the domain of

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<sup>18</sup> The selected example is Cussins proposal [Cussins1992] which is presented unmodified but substantially abbreviated. Parallel examples might have been derived from Smith or Clark [Smith 1996; Clark 1997].

<sup>19</sup> Cussins 1992 pp 664-670.

embodiment are not abilities of a subject but 'trails' through an environmental feature domain.<sup>20</sup> Their existence and intersection differentiates the domain into feature space.

A 'cognitive trail' is a co-ordination, represented non-conceptually in the domain of embodiment. An individual capable of some form of experiential registration moving in an environment, will register patterns of experience which are an undifferentiated function of what it does and the constitution of the environment. But although we as theorists and observers are able to express what happens in terms of an individual which is objectively separable from the environment, the individual is unable to do this. It will simply register patterns of activity of its domain of embodiment. If it walks up an increasingly steep slope then it will register changing patterns of its bodily activity, but will not be in a position to attribute these to an objective property of the environment, but only as embodied changes that take place. If it encounters an obstacle, then this will be registered as a different set of de facto changes in its own activity patterns.

Nonetheless, patterns relative to its feature space are laid down and will hold relations to other patterns. Where patterns intersect, the possibility exists for shifts from one co-ordination (or trail) to another. The structure of feature space consists in the network of intersecting trails which facilitate shifts in co-ordinations, and which in terms of the navigation analogy constitute the system of landmarks which enable a navigating organism to be increasingly perspective independent (having a high PD ratio).

Although it might be tempting to equate a high PD ratio with generality, this strategy will not work since the problem is to explain generality within the experiential framework rather than accept it as a given. In order to do this we will need to be able to map generality in terms of at least two dimensions if we are to get beyond simply using the PD ratio as a relative measure of satisfaction of an unanalysed generality constraint.

The second dimension proposed by Cussins is a developed form of the notion of 'stabilisation' drawn from the work of Latour.<sup>21</sup> The idea is that given a phenomenon that is complex or in flux, a physical or conceptual boundary is constructed to contain it so that it can be referred to or presumed to function as a singular unit. Stabilisation in the context of feature space is equivalent to representing a network as a single entity, which

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<sup>20</sup> Cussins uses the term 'cognitive trails' to suggest the twin aspect of environment and experience.

<sup>21</sup> Latour 1987. Latour's concept of stabilisation which is also referred to as 'black boxing' is similar in many respects to 'chunking' strategies deployed in psychology and information theory [as represented in psychology for example in Miller 1956, and information theory by Dretske 1981]. It is also familiar in the technological transition from early prototype products to mass market items, where initially complexity is evident at every stage in the use of the product but where in later models although the content of the product may be more complex, use is simple and unitary. Latour cites the development of the Kodak camera as an example of this form of development.

can then become a point in a higher order feature space.

**'A simple animal structures its world around obstacle-avoidance, trajectories of predators and prey, imminence of mates, and expends its cognitive energy maintaining networks of trails for these feature-spaces. A cognitively more sophisticated animal stabilises the feature-spaces of the simple animal and then has these serve as points in higher-level feature-spaces. Many stabilised levels in the hierarchy must be passed before an animal's zone of obstacle avoidance becomes what is for a human a tree on a hillside.'** <sup>22</sup>

Stabilisation as a metric is equated with the extent to which the higher order representation of a feature-space can function across contexts, without having to break into the substructure. In the higher order case of language for example, where networks are stabilised by predicates, this is equivalent to a measure of the extent to which a predicate can function across linguistic contexts without having to unpick the sense or reference of the term in particular contexts.

Stabilisation and PD ratio are independent metrics characterising different functions of feature-space. The two dimensional space mapped in terms of stabilisation and perspective dependence, is the ecological space defining the interaction between subject and object. The portion of space close to the origin, with low stabilisation and low PD ratio is equivalent to undifferentiated experience with little metaphysical distance between subject and object, and low generality. The portion of space furthest from the origin, with high stabilisation and high PD ratio, represents the area of maximal metaphysical distance between subject and object (they are formally separate and treated as explanatorily independent), and high generality. The two dimensional space itself maps representational space, and suggests a continuity between experiential and propositional knowledge which are ultimately grounded in embodied non-conceptual content.

Although the example is essentially a philosophical and cognitive thought experiment, an empirical basis for a stance of this kind can be found in connectionist approaches to cognition. The basis for this lies in the deployment of connectionist networks in pattern mapping tasks.<sup>23</sup> Pattern recognition in multi-layered networks have for example been used to model perceptual processing and categorisation, including cases where networks have been interfaced with an actual environment by including sensory and motor layers.<sup>24</sup>

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<sup>22</sup> Cussins 1992, p 679.

<sup>23</sup> Pattern mapping is used here as a general term to encompass pattern recognition, pattern matching, pattern transformation and pattern association.

<sup>24</sup> Bechtel and Abrahamsen provide a useful overview and review of developments in pattern mapping and pattern recognition and their relation to perceptual and cognitive models [Bechtel and Abrahamsen 1991]. Clark reviews the more recent developments particularly in relation to cognition, artificial intelligence and robotics [Clark 1997]. Smith approaches the problem of embodiment from a computational perspective and develops a model along similar lines to Cussins, but in the form of a more general metaphysical framework [Smith 1996].

The results of such studies suggest that given a minimal level of sensory and motor capability, and interactivity with an environment, connectionist networks yield categorial structures which are sufficiently stable and general to constitute conceptual schemes.<sup>25</sup>

The product semantic framework does not require that the whole of cognition, including the genesis of conceptual structure be explained in terms of bottom-up elements. Indeed in the interests of preserving the idea of conceptual relativity, the bottom-up element is ultimately marginalised. However, if the two explanatory orders operative within product semantics are kept distinct (meaning as intrinsic semantic content, and meaning as significatory) as proposed in the conceptual re-orientation, then respectively they provide the basis for the two functions required to map representational space in Cussins scheme.

The significance of this is that it opens up a different perspective on an experientially based semantic theory. The interaction of a species with its environment establishes sets of affordance relations, which are the ecological expression of its competences and its discriminatory ability. The kind of world which an organism can have, is constituted in the development of its systems relative to affordance relations. This capacity is the equivalent of the organism's perspective dependence. If distinct explanatory orders are maintained then the product semantic framework can provide the basis for the second metric - stabilisation - in terms of the significatory function of the elements of language and communication systems. A core function of such elements, which have no intrinsic semantic content, is behavioural coordination, through which they can acquire associated semantic content and mobilise the constructive sense of representation.

### *Experience, Awareness and the Role of Concepts*

The example demonstrates how structure in embodied representation might arise from an ecological relation given some low level sensory/behavioural capacity and an ability to distinguish between different ecological states on the basis of embodied 'feel'. Escalation of structure and the encapsulation of components of structure, account for increasing metaphysical distance (separation of subject and object) and the possibility of propositional representation where this value is high, and where stabilisation is achieved through the role of co-ordination conventions.

Philosophically, the extremes of representational space can, for example, be equated with the distinction between a perceptual experience of 'x' and a perceptual belief about 'x' - an awareness of things and an awareness of facts. It is possible to be sensorily aware of

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<sup>25</sup> What appears to be missing in Cussins scheme is some basis for the application of the stabilisation metric - although its function is clear, its genesis is not apparent.

something without knowing what it is that one is sensorily aware of - aware of a smell, without knowing that what one is aware of is the smell of the toast burning. The extension of this, is that one can be conscious of something without knowing that one is conscious of it.<sup>26</sup> The upshot is a thesis which rejects the idea that what makes an experience of 'x' conscious, is not that one is aware of the experience, but rather that :-

'...being a certain sort of representation, it makes one aware of the properties (of *x*) and objects (*x* itself) of which it is a (sensory) representation. My visual experience of a barn is conscious, not because I am introspectively aware of it (or introspectively aware that I am having it), but because it (when brought about in the right way) makes me aware of the barn. It enables me to perceive the barn. For the same reason, a certain belief is conscious, not because the believer is conscious of *it* (or of having it), but because it is a representation that makes one conscious of the fact (that *P*) that it is a belief about. Experiences and beliefs are conscious, not because you are conscious of them, but because, so to speak, you are conscious *with* them.'<sup>27</sup>

'The claim is not that we are unaware of our own conscious beliefs and experiences (or unaware that we have them). It is instead, that our being aware of them, or that we have them is not what makes them conscious. What makes them conscious is the way they make us conscious of something else - the world we live in and (in proprioception) the condition of our own bodies.'<sup>28</sup>

Dretske's proposal regarding the logical and empirical status of experiences and beliefs accomplishes two things which are of importance in the context of the experiential basis of cognition. Firstly it provides a way of making sense of having experiences which does not depend on the idea of consciously examining their content. Secondly it provides the same basis for making sense of our experience of the world, as of our own states.

Given the previous discussion of the nature and role of concepts, it is possible to posit the idea that what makes experiences conscious, as opposed to simply structured, is their function relative to the coordination relations established in interaction. In other words Dretske's '..when brought about in the right way' is interpreted as 'in the context of interactive coordination'. Although the integrative and explanatory value of such a move

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<sup>26</sup> There is an overarching sense of what it means to be conscious which encompasses both intransitive (being conscious, not being unconscious) and transitive senses of consciousness (being conscious of something). Rosenthal uses the term 'creature consciousness' to cover this overarching sense. This is contrasted with 'state consciousness' which is the transitive sense in which internal states and processes are said to be conscious. [Rosenthal 1986,1991]. Dretske argues on the basis of Rosenthal's distinctions that one can logically be conscious of something without knowing it. The empirical basis for the contention is based on examples such as concept acquisition in monkeys [Gibson E 1969]. Monkeys are trained to respond to the larger of two objects, and to an intermediate size relation, by exhibiting a differential response which they are then able to generalise. The question arises as to the perceptual content that is available to the monkey prior to acquiring the explicit discriminative ability. A monkey that acquires the 'larger than' relation has all the perceptual discrimination needed to acquire the 'intermediate size' relation, but may not do so. [Dretske 1993].

<sup>27</sup> Dretske 1993, pp 280-281.

<sup>28</sup> Dretske 1993, p 281.

is clear, it would, given the lack of a more comprehensive framework for unpacking the idea, be a speculation too far.

It is sufficient for the present discussion to note that given the reconstructive analysis of product semantic concepts, and the nature and role of experiential content, there is a substantive basis for reworking a philosophical and theoretical stance which gives priority to experience in the development of a cognitive and semantic explanatory framework.

### *Possible Implementation*

The clue as to how the broader framework could be implemented might again be drawn from connectionist approaches to cognition. The stimulus for connectionism in this context, has largely derived from the problems associated with modelling cognition in terms of symbolic processing. Intentionality, as the philosophical term which designates the property of 'aboutness' characterising mental states (their content or meaning), is normally expressed in terms of a relation that obtains between the state and some external circumstance. On the computational model prevalent in cognitive science, mental states are conceived as symbolic, and mental processing as symbol manipulation, and therefore syntactic. In order to derive a semantic property for mental states, the symbols require interpretation, either through the specification of extension or intension. But the expression of an interpretation for a symbol will in turn be symbolic, leading to a regress, unless there is some non-symbolic relation which can ultimately ground the syntax.

The prime candidate is that semantic interpretation is grounded in some form of causal or covariational relation - that tokenings of mental states are caused by particular states of affairs in the world. If this idea is taken literally and directly, then it leads to the problem of how it is then possible to account for error. How can I be mistaken in respect of a belief that there is a desk in front of me if the content of my belief is defined in terms of its being caused by a desk in front of me? The principal distinction in philosophical strategies for defining semantic interpretation, consists largely in differences of approach in allowing for the possibility of error, and on the face of it none of these succeed.<sup>29</sup>

The problem however need not be traced to the basic inadequacy of some form of causal account, particularly since it would be extremely counter-intuitive to suppose that states of mind are radically disconnected from states of the world. The alternative would be to

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<sup>29</sup> Cummins critically reviews the principal forms of such theories [for example Fodor 1987; Dretske 1981] and demonstrates the problem of allowing for the possibility of error in all forms of causally based symbolic computational theories [Cummins 1989]. In his more recent work this problem assumes so great a status that an account of the propositional attitudes and the role of representations is driven from the perspective of how to allow for error [Cummins 1996].



acknowledge that some sort of causal connection exists between states of the world and internal states, but that it is difficult to square a causal account with the idea of symbolic processing. In order to exploit the idea of computationalism, symbols are treated as atomic, arbitrary and context free. Thus although a symbol might be tokened (in some way) by an external referent, once tokened it is divorced from its referent during processing. Given the constraints on the properties of symbols implied by computationalism, which derive from the in-principle equivalence of tokens, it becomes difficult to account for the evident context dependence of intentional states.<sup>30</sup>

The alternative approach is via connectionism, which does not involve a discontinuity between the idea of computation and causal processes, and which yields structuring principles which are representational in the sense noted above. However, there are also disadvantages, including the difficulty in accounting for compositionality.<sup>31</sup> One approach which offers the prospect of a general solution, sets the basis for symbolic processing and rule structures in external rather than internal symbols.<sup>32</sup> The idea is roughly that cognitive systems are implemented as connectionist networks which operate in terms of pattern matching, but develop the capacity to interpret and produce symbols external to the network.<sup>33</sup> A substantive basis for implementing the idea of external coordination as the basis for symbolic processing, is represented in the proposed dual basis for meaning grounded respectively in representational content and in coordination.<sup>34</sup>

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<sup>30</sup> Dreyfus 1979 The two obvious alternatives are either to infer different symbols for each 'token plus context' or to employ additional context defining symbols and rules for their application in the derivation of complex semantic interpretations. Neither is particularly attractive. The former because of the proliferation of symbols and the loss of significant semantic compositionality, and the latter because of the implied relativity of token-type relations. In respect of the former, one of the prime reasons for adopting a computational approach in the first place is that it promises to account for the open endedness and compositionality of natural language. Although the latter preserves the idea of compositionality, it does so at the expense of clear criteria for the differentiability of tokens, which is necessary to the operative notion of symbolic processing.

<sup>31</sup> See Fodor and Pylyshyn's critique of connectionism, which they treat as a failed form of representationalism (lacking a combinatorial syntax and semantics). Although they acknowledge that at a neurophysiological level there might be a connectionist implementation, they argue that this has no bearing at the level of cognitive explanation [Fodor and Pylyshyn 1988].

<sup>32</sup> Rumelhart et al 1986; Smolensky 1988; Clark 1989.

<sup>33</sup> This is possible, for example, because we are born into communities which use external symbols and these form part of the environment in which we develop, allowing us to interact with symbols as part of the general pattern of interaction, without the need to internalise them explicitly. [Bechtel and Abrahamsen 1991, pp248-254]. Rounding out the picture without regress, in the cited context, is clearly a complex matter, since no basis is established for this capacity. In the proposed interpretation of the product semantic account the basis is provided in the distinction between signals and representations and their interaction.

<sup>34</sup> Cussins 'stabilisation' dimension for example could be construed along these lines, in the context of human cognition. The idea is also closely related to Miller's conception of objectification in the analysis of artefacts [see p 185 above]. Philosophically it is also the core of Wilson's treatment of the idea of 'wide computationalism' which extends the system in which computation takes place to include the external environment and the physical and representational transactions with that environment [Wilson 1994]. Clark argues that a perspective of this kind has been essential to the development of robots and artificial intelligence, and points to the necessity of the approach in modelling human cognition [Clark 1997].

## 11.5 Summary - Semantic Theory and Cognition

- a) Product semantics proposes an experiential approach to semantic theory and cognition. The dominant models in the theory of mind and mental representation give priority to representation in thought (language) rather than experience. This is also the position reached in the product semantic account, since the framework is driven top-down.
- b) In order to ground semantic and cognitive theory in experience, it is necessary to show how certain features driving representational models (eg subject/object, sense/reference distinctions) can arise in experience without their prior assumption. One way of framing the problem is in terms of the idea of non-conceptual content - is it possible to characterise representational states non-conceptually ?
- c) Non-conceptual content can be given sense via the development of criteria for representation which do not rely on the priority of concepts, and which can be developed in terms of the experiential idea of abilities to act (affordances), and the concept of a 'feature placing' language.
- d) Taken together, these enable the experiential approach to cognition to be framed in terms of the question of how non-conceptual representation based on feature-placing can acquire the structure to support subject/object, and sense/reference distinctions - how can metaphysical distance be achieved ?
- e) In order to achieve metaphysical distance, two distinct metrics are necessary (the conceptual space must at least be two-dimensional to map representational generality). One metric relates to the experiential content of abilities to act, whilst the other is an 'arbitrary' metric whose function is to stabilise patterns in experiential content.
- f) The conceptual re-orientation of the product semantic framework is distinctive in proposing two sources of meaning - one of which is defined in terms of the experiential content of affordances; the other in terms of the function of 'arbitrary' signals in behavioural co-ordination. These can be viewed as implementations of the two metrics necessary for defining representational space.
- g) There is a substantive basis in the product semantic account, if the arguments of the conceptual re-orientation are accepted, for an experiential approach to semantic and cognitive theory. (An outline physical implementation of the framework can be envisaged in terms of a broad connectionist model encompassing external 'symbols').

## Section 12 Conclusion

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## 12.1 Conclusion

Product semantics proposes a theoretical framework for design which is based on the idea that its proper conceptual basis rests on a deep understanding of user-product interaction. The broad task framed at the outset of the study was to establish the conceptual structure of the product semantic framework, in so far as the material and form of the accounts offered would allow, and to evaluate the framework in terms of its consistency, coherence and conceptual utility.

### *Stagesetting*

The product semantic stance and its sources were analysed and the results outlined in Part A (section 2), the principal elements of which can be summarised as follows:

- a) The product semantic account stems from an eclectic critique of design practice and theory which is approached from historical, philosophical, theoretical and methodological standpoints, and expressed in the form of a contrast between 'models' or 'paradigms'. In prosaic terms the contrast between paradigms can be expressed in the distinction between a core design-centred model and a core user-centred model.
- b) The positivist philosophical stance which centralises 'function' and the associated intentionalist sense of the design process (which are taken to typify the prevailing paradigm underlying much of contemporary design theory), is rejected in favour of a philosophical stance which is relativistic and epistemological in orientation.
- c) The product semantic account argues that the prevailing paradigm essentially works with the idea of the product as an object with specifiable content derived from the intentionality of the design context, and that its articulation in formal and theoretical terms is primarily associated with the centrality of the concept of 'function'.
- d) The underlying assumption that formal content defined from a design standpoint can provide the common ground in what can be understood about the product from a design standpoint and what can be understood about the product from the perspective of the user, is rejected. Product semantics argues that there is no basis for the assumption, and pursues the theme in terms of a semantic model
- e) If the articulation of content from a design standpoint centralises 'function', then the articulation of content from a user perspective centralises 'meaning'. What is important from a user perspective is the 'construction' that is placed on a product by the user.

- f) Meaning is conceived as a holistic concept, on an analogy with 'direct perception', which captures the idea of the form in which the product is assimilated by the individual - it is what we can 'make' of the product - and this metaphor is interpreted both in terms of how we can understand the product, and what we can do with it.
- g) 'Making something' of a product is not restricted to the level of simple instrumental engagement. We are cognitively complex, and interaction at the physical level is as much articulated conceptually as it is perceptually, and much of the conceptual structure that we have is evident to us through language and in terms of the nature of social transactions.
- h) The product semantic conception of meaning bundles up a complex of elements which includes identity, social role, provenance, use and personal association. These are taken to comprise the different ways of placing a construction on something and are represented formally in terms of 'meaning contexts' (use, language, genesis, ecology). In relation to these, 'meaning' consists in the collection of significances associated with the ability to place something in context.
- i) The principal theoretical approaches adopted in unpacking 'meaning', reflect the two aspects of meaning noted above - signification and contextualisation. Signification is approached primarily in terms of a semiotic conception, whilst contextualisation is addressed in terms of a semantic and cognitive model. Although these are formally distinct, they are conceptually congruent and articulated in terms of a number of common concepts - 'function' (which is rejected), 'affordance', 'categorisation', and 'meaning'.

### *Analysis*

The strategy adopted in pursuing the detail of the account, consisted in the reconstructive analysis of the sequence of key concepts noted above (Part B, Analysis). The principal conclusions derived from the analysis can be summarised as follows :-

#### *Function*

- a) Product semantic accounts reject the centrality of 'function'. This is based on an implicit but unanalysed sense of function, which assumes that it is both determinate and deterministic. It is argued on the basis of an analysis of function, that this is not the case, but rather that it is a relational concept reciprocally linking means and ends, and is both normative as an institution and context dependent. In the case of artefacts it is normally grounded in agent intentionality, and more generally in the idea of a context for selection. It is argued that this does not align with the implicit sense in which it is deployed in

product semantic accounts, and that the case for the rejection of function is not well made. The analysis of function in terms of contexts for selection also provides the basis for an initial consideration of the relationship between function, intentionality and meaning, relative to the use of these terms in characterising system states. (Section 3, Function).

### *Affordance*

b) The concept of affordance (and the related concept of perceive-affordance) is central to the product semantic framework, giving substance to an experiential sense of significance and meaning, and an 'ecologically' conceived context for linking meaning with form. It is argued that the use of the affordance concept in product semantic accounts is equivocal. It is deployed at a basic level (in a Gibsonian sense) to characterise the holistic and action-centred nature of perceptual and operational engagement, and also by extension to higher levels in the context of an interactive systems model, to encompass conceptual holism. In this latter and broader sense, the analysis of affordance demonstrates that the concept can be understood in terms of the idea of contextual sufficiency. Nevertheless it is concluded that the utility of the concept at a basic level is dependent for its explanatory power on its relation to an underlying evolutionary theory (in the form of teleological semantics), and in this sense it cannot be directly extrapolated to more complex cognitive contexts, in the way that the product semantic account proposes. (Section 4, Affordance).

### *Categorisation*

c) The concept of categorisation is deployed in the product semantic account in two main ways - as a model of the ecology of product relations, and as a model for cognitive processes generally. The account rests in both respects on a prototype-semantic model of categorial structure. It is argued that prototype-semantics is insufficient per se to account for the empirical results encountered, in the case of both concrete and abstract concepts, and that the relation between categorial and conceptual structure is more complex than is suggested in the product semantic account. Alternative approaches to categorisation and the characterisation of conceptual structure are reviewed. These include the challenge posed to both classical and prototypical categorial approaches by the 'theory' theory, philosophical 'essentialism' represented in the causal theory of reference, and related empirical studies in psychology in respect of the nature and assimilation of 'kinds'. It is concluded in the light of a consideration of the role of 'schemas' in the relation between concrete and abstract concepts, that there is a substantive basis for grounding prototype structure in a bodily-based schematic concept (basic affordance), and an identifiable role for 'naming' (and language generally) in the relation between the taxonomic and thematic aspects of categorisation. (Section 5, Categorisation).

### *Artefacts*

d) The core product semantic concepts are deployed in the context of an implicit 'artefact' or 'product' model, the nature of which is established in the study by comparison with a range of models represented in the literature. The product-model space for the analysis is articulated in terms of two axes - one representing the distinction between 'place-marker' and 'content' models, and the other the distinction between approaches focusing primarily on the 'individual' or on 'collectives'. Mapping to the model space enables a range of different approaches to be canvassed, and the relationship between them to be clarified. It is concluded that the implicit product semantic model embodies elements represented in a number of these approaches (including instrumental, intrapsychic and socio-cultural components) but that two different conceptions are articulated - one associated with a design context and the other associated with user-interaction. In relation to the core theme of user-interaction, the implications include a rejection of the idea of the objectifiability of content, and a conception that the product is constituted in the process of interaction, and that product content is an inherent part of the process of signification. Syntax and semantics are constructed in parallel. Methodologically the approach is found to be more consonant with a typologically based communication model rather than a set-theoretic or truth-functional basis for characterising product content. (Section 6, Artefacts).

### *Meaning*

e) Meaning in product semantics is conceived as a complex mental construct resulting from a cognitive process involving signification. The form of the signifiatory process is modelled variously in terms of use, affordance, categorisation, linguistic attribution and contextual fit. In relation to these, product semantic accounts advert to a number of distinct contexts and approaches in the theory of meaning, which are addressed in the study. In the broad context of meaning in language it is argued that the product semantic account is incompatible with a set-theoretic or truth-conditional approach, but has affiliations with aspects of referential, ideational and behavioural theories. These are most strongly represented in the use of aspects of speech-act theory and intention-based semantics, cognitively grounded in intentional and representational theories of mind. The principal alternative consists in approaching signification via semiotics. It is argued that the two approaches converge, both in respect of a core characterisation of significance in terms of exemplification, and in the broader context of folk-psychological senses of meaning. It is concluded that the account attempts to reconcile a folk-psychological view of meaning expressed in terms of intention-based semantics with a representational conception of mental states, and a use theory structured in terms of conceptual categories derived from socio-cultural 'forms of life'. (Section 7, Meaning).

### *Expression*

f) Extending the approach to meaning derived from the idea of perceive-affordance, links the analysis of meaning with the idea of expression, linguistic attribution and the role of metaphor as an associative form of representation, which are essential elements of the theoretical and methodological content of product semantic accounts. The nature of expressive and affective content are considered in the light of the role of linguistic attribution and metaphor in the overall scheme. It is concluded that in spite of the commitment to a broader conception of the nature of individual experience, experiential content is assimilated to the categorial and propositional aspects of exemplification and contextual fit, in product semantic accounts. In the case of metaphor the principal theoretical approaches are canvassed (pragmatic theories, semantic theories, cognitive reconstruction, semiotics) and provide the basis for an approach to metaphor in the case of artefacts. It is concluded that metaphor on the product semantic account does not include direct experiential exemplification, but consists in associative relations in a representational scheme or network, primarily articulated in terms of kinds and properties. (Section 8, Expression).

### *Synthesis*

The conceptual orientation and content of the product semantic approach outlined in the stagesetting (section 2), taken together with the reconstructive analysis of concepts (sections 3 - 8), provides the basis for the consideration of the framework as a whole.

### *The Product Semantic Framework*

In Section 9.2 these are drawn together in a reconstructive recapitulation of the product semantic argument, which represents the most explicit form in which the explanatory framework as a whole can be expressed, and provides the background against which further consideration can be given to the role of concepts, and questions of consistency and coherence. The recapitulation demonstrates the all-through aspirations of the explanatory framework, and the way in which individual concepts are deployed in driving down to an account of user-interaction, articulated semantically, and grounded at the level of cognitive functioning. The core of the explanatory structure can be summarised as follows :

a) User interaction can be expressed as a communicative function of the relation between formal content and procedural role, on the assumption that they are co-constructed. The naturalness in the experience of some procedural patterns, and their relations, are a



measure of what the user brings to the interaction. These can be modelled holistically in terms of affordance.

b) User interaction processes can be characterised semantically in terms of a context-dependent constructive process of signification conceived operationally and in terms of psychological individualism. Meaning constructs are co-ordinated to the extent that we share 'forms of life' (reflected in meaning contexts).

c) The semantic account can be grounded cognitively by trading on the explanatory resources of 'representation'. The holistic character of cognition is captured by an extended sense of affordance, and conceptual structure modelled in terms of the processes of categorisation and attribution.

### *Concepts and Conceptual Relations*

Although the explanatory framework represented in the argument structure is coherent, in the sense that it represents the particular instantiation of a commonly accepted hierarchical approach to cognitive characterisation, it is argued that the deployment of concepts within it leads to inconsistency. The principal conclusions drawn from the thematic consideration of the interaction of elements within the framework (section 9.4), can be summarised as follows :

a) The relations between meaning, significance and understanding are inconsistent in conflating public and private aspects of meaning and understanding, and normative and individualistic conceptions of signification. In addition constructive and holistic views of meaning are conflicting in the context of the product semantic account. A parallel problem is evident in the prototype-semantic form of the scheme for categorisation, which conflates holistic and attributive models. Generally, psychological individualism is juxtaposed with extensional definition and these are normally taken to be incompatible.

b) The framework is grounded cognitively in terms of the explicit role of affordance and the implicit idea of mental representation. Interpreting affordance and representation in terms of higher level conceptually driven constructs (in the form of contextual sufficiency, and attributive association, respectively), robs them of explanatory power at the level of cognitive functioning.

c) Inconsistency in the product semantic account can also be traced to the rejection of a distinction between perception and cognition, coupled with a liberalisation of the concept of affordance; the attempt to reconcile an intentional approach to semantics, with a

representational account of mental content, and meaning holism with a constructive account of semantic content. Expressed in its most general form, the overarching problem with the scheme lies in the conflation of distinct explanatory levels.

d) The framework is conceived experientially, but its implementation assumes that experiential content can be assimilated to attributive models of content.

In generalising an account in terms of which product interactions can be explained and ultimately predicted and synthesised, cognitive and semantic models are harnessed. But the framework is modelled directly in the terms of the components of the analysis of user-product interactions, and the properties of this representational medium are assumed to be matched in the cognitive and semantic domains. A descriptive model of product interaction is therefore used as the basis for an explanatory model for the processes that it describes.<sup>1</sup> In order to make the account workable it is necessary to maintain a distance between cognitive models and the processes that they are invoked to explain. It is also essential that they are applied at an appropriate level of explanation.

The distinction can be expressed in terms of extensional orders. First order extension is concerned with experiential content. It provides the presupposition and basis for second order extensional accounts, whose aim is to elucidate the physical basis of the phenomena of experience - to provide the structure for an explanation. At this second level, 'content' refers to the instantiation of the explanatory structure with a particular set of values. There is however a further sense of 'content' which is not explained by the second order extensional account - the subject matter of the experience (what it is about) - which is a property associated with an interpretation of first order extension. Nevertheless some form of connection between extensional orders is normally assumed in cognitive accounts, to preserve the intuition that experience and meaning are ultimately grounded in the way that we are constituted physically ('naturalisation' of content).

The product semantic account blurs extensional orders in a particular way. In maintaining conceptual parity for affordance across levels, it assimilates second order extension to the idea of meaning that arises out of first order extension. The replete sense of meaning applicable in the context of product identities, attributes and qualities is implicitly transferred to the second order extensional account of cognitive states. In this way the explanatory order is inverted, and the properties of the modelling medium are attributed to

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<sup>1</sup> In the case of Krippendorff's 'contexts' for example, the set of higher level transactions are taken to be cognitive models whose content is assumed to match the relations found in the analysis of the external features of the context. Similarly, Athavankar's categorisation model, which is based on a lower order explanatory scheme derived from cognitive psychology, acquires characteristics from the higher order context of product taxonomy which are then attributed to the lower order model. In Gaukroger's sense, the 'domain of evidence' is conflated with the 'domain of investigation'. [See appendix A, 'Framework Models'].

the system that is being modelled.<sup>2</sup> Generally in cognitive accounts the ‘naturalisation’ of content runs in the other direction. The content (meaning) that arises out of first order extension is conceived as supervening on it in a parallel way to that in which first order extension supervenes on second order extension. Neither alternative is entirely satisfactory - the product semantic account because it ultimately defies grounding in physical systems, and the computational cognitive model because it assumes that grounding in physical systems is unitary and sufficient in itself to support semantic constructs.

### *Conceptual Re-Orientation*

In Section 10 it is proposed that these problems can be resolved by re-orienting elements of the framework in recognition of distinct explanatory orders. The principal conclusions drawn can be summarised as follows:

- a) The need to sustain individuation in terms of both ‘contents’ and ‘targets’ (psychological individualism and wide content) can be met if it is recognised that they belong to distinct explanatory orders. At the level of cognitive explanation, affordance and an associated relational analysis of function provide the basis for grounding the semantic account cognitively, in the general context of a teleological approach to semantics (and content can therefore be ‘naturalised’). The context-dependent nature of function allows for context sensitivity in respect of individuation relative to targets, and gives substance to the product semantic conception of the co-development of syntax with semantics.
- b) ‘Representation’ has two distinct senses in a product semantic account which should be associated with different explanatory orders. As a grounding concept for cognitive explanation it can be analysed in terms of isomorphism between system states and states of the world in the context of affordance relations, and in this sense has intrinsic semantic content. As a higher order constructive concept (in the semantic specification of objects in terms of representational content) it is dependent on conceptual structure articulated in terms of a signficatory scheme.
- c) Cognitive content (the way that we conceive things) can be explained in terms of two constructs, one of which is based on isomorphism between systems states and states of the physical world, the other on signficatory conventions in the de facto co-ordination of systems. The former is essentially a semantic construct (has representational content) the latter is essentially non-semantic (has no representational content, but operates like a

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<sup>2</sup> The general problem of reading the properties of the representational medium into the realm of what is being represented, in cognitive accounts, is analysed by Matthews, who argues that it is methodologically safer to model intentional contexts on an analogy with a measurement-theoretic account [Matthews 1994].

signal). The former constitutes the substructure for perception and experiential content and gives rise to dense non-notational schemes, whilst the latter approximates to a notational scheme which can exhibit compositionality.

d) Meaning is a higher level construct derived from the interaction between two hierarchical orders, one based on the role of representations in the context of affordance, the other based on the role of signals in behavioural co-ordination. The first is non-arbitrary in the sense that the particular isomorphisms that are operative are phylogenetically determined - we are what we are and have the world that we have because of our evolutionary history. The second is arbitrary in the sense that although signifiatory conventions necessarily arise out of coordination, the form of those conventions is not necessary.

### *Experiential Content*

The product semantic scheme emphasises subjectivity and experiential content in the rationale for semantic and cognitive accounts of user interaction, but in the move to a top-down concept-driven conception of the framework, aspects of experiential content are marginalised (section 9.4). In section 10.4 the question of experiential content is revisited in the light of the more general proposals for the conceptual re-orientation of the framework, and approaches represented in the literature. The principal conclusions drawn can be summarised as follows:

- a) A significant sense of experiential content is represented in the idea of 'knowing how' which can be related to holism in the characterisation of expert performance, and the roles of affordance and representation in the product semantic framework. The key articulating concept for experiential content is affordance.
- b) Product semantic emphasis on the action-centred and context-dependent nature of interaction is also evident in situated models of judgement and reasoning, and these jointly map to a conception which centralises 'simulation' models rather than 'planning' models.
- c) The affective states can be viewed as having a representational function in cognition, modelled on the 'internal' aspect of the affordance relation.

### *Implications for Design Theory*

The product semantic framework is derived from a philosophical, theoretical and methodological critique of a particular conception of design. The substantive proposals

developed from this draw on the broader context of semantic theory and cognition in the characterisation of user interaction as a core element of design theory. The significance of the product semantic account, and the conceptual re-orientation, for these areas of activity are considered in Section 11. The implications of the study for design theory and methodology (Section 11.2) can be summarised as follows:

- a) In contrast with the 'prevailing paradigm' the product semantic account locates the core problematic in design in the sphere of consumption, and the inferred form of the design process locates the model for semantic structure in the socio-cultural domain. This semantic structure is conceived in terms of 'meaning', 'perceive-affordance' and 'affordance' which underpin user-interaction. The concept of affordance is pivotal in providing a grounding for higher level meaning constructs, but is also defined in terms of these higher level constructs, which leads to inconsistency in the account.
- b) The explanatory structure of the framework, and its top-down orientation can be expressed in terms of a non-reductive (supervenient/subvenient) hierarchy of relations.
- c) The proposed conceptual re-orientation, which addresses the inconsistencies in the framework, can be expressed in a parallel form. The resulting model conceives meaning relations as the higher level constructs arising from the interaction between two parallel hierarchies of relations, based respectively on affordance and co-ordination.
- d) Products, together with cultural output generally, occupy the interactive space between orders, and need to be conceived in terms of their dual role as behavioural co-ordination signals, and as experientially represented objects. In terms of the wider cognitive tradition, this would suggest articulating design theory and methodology in terms of the application of, and interaction between, physical, conceptual and affective schemas.
- e) The place of products in the semantic and cognitive order can also be expressed in terms of a sense of 'product ecology', in which products are conceived along the lines of traits or attributes of human beings, in addition to the dominant conception of 'product ecology' which treats them as a relatively independent order of artefactual species.
- f) There are no good grounds for excising 'function' from design theory. The assertion of independence for semantic structure in the socio-cultural domain does not preclude a role for 'function' in structuring the techno-physical domain. The product semantic model can be broadly expressed in terms of the structure of the two domains and their inter-relating elements.

### *Implications for Semantic Theory and Cognition*

The commitment of the product semantic account to an experiential approach to semantic theory and cognition is not realised in the detail of the account, gravitating to a top-down emphasis, which in common with the broad thrust of cognitive accounts, gives priority to representation in thought and language rather than experience. In re-asserting explanatory orders and the role of basic affordance in the framework, the arguments of the conceptual re-orientation open up the possibility for a further consideration of the implications of the product semantic stance for semantic theory and cognition. This is addressed in section 11.4, and the principal conclusions drawn can be summarised as follows :

- a) The problem of grounding semantic and cognitive theory in terms of experience can be assimilated to the question of whether representational states can be characterised in terms of non-conceptual content, and whether these can be related in some way to undifferentiated experiential content. It can be shown that criteria can be framed for representation which do not rely on the priority of concepts, and that there is a basis for undifferentiated content in the idea of 'feature placing'.
- b) In order to acquire the structure necessary to achieve metaphysical distance (for example, to achieve subject/object or sense/reference distinctions, without their presupposition), it has been demonstrated that two distinct metrics are required to map representational generality, one of which can be expressed in terms of the experience of abilities to act, and the other as a stabiliser for patterns in experiential content.
- c) The proposed conceptual re-orientation of the product semantic framework is distinctive in identifying two sources of meaning - one defined in terms of the experiential aspect of affordances, the other in terms of the function of arbitrary signals in behavioural co-ordination. These can be viewed as implementations of the two metrics necessary for defining representational space. There is therefore a substantive basis in the account for an experiential approach to semantic and cognitive theory.
- d) An outline physical implementation can be envisaged in terms of a broadly connectionist model, encompassing external 'symbols'. The approach is compatible with some recent developments in cognitive science and philosophy, which are also associated with an emphasis on the priority of experiential content in deriving cognitive accounts, and with establishing the role of the external environment in cognitive development.

### *Summary*

Product Semantics proposes a theoretical framework for comprehending user-product interaction. The substance of the proposal consists in the application of semantic models in characterising the structure and content of interactions. The rationale for the use of these models lies in their perceived capacity to capture user perspective, which is elided in the central role given to 'function' in traditional accounts of design, and to provide the link between the roles of products as elements in individual and in cultural expression.

The product semantic analysis draws on a number of constituent or contiguous concepts, including 'meaning', 'affordance', 'significance', and 'categorisation', which give shape to the detailed clarification of the nature of interaction. The explication and use of these concepts supports the implementation of a constructive approach to semantic analysis and a cognitive and experiential account of user interaction, although no detailed and explicit theoretical commitment is made in either regard. Nevertheless, if the analysis of individual concepts is pursued in terms of the theoretical commitments that are either adverted to or implied, it is possible to derive an analysis of individual concepts and an explanatory argument structure, consistent with the aims and content of the programme.

Given the core commitments and the argument structure of the product semantic account, the conceptual framework is subject to inconsistency. The source of the inconsistency can in large measure be traced to the conflation of explanatory levels, and the liberalisation of the concept of affordance, in terms of contextual sufficiency, across explanatory levels.

If it is assumed that the core commitments are tenable, then it is possible to derive an alternative and more consistent analysis, the core of which depends on reasserting the status of the concept of affordance as a ground level construct, and the assertion of distinct explanatory orders. Higher level constructs such as meaning are derived from the interaction between two hierarchical orders, one based on the role of representations in the context of affordance, the other on the role of signals in behavioural co-ordination.

The broad implication for design theory is that products, together with cultural artefacts generally, occupy the interactive space between orders, and need to be conceived in terms of a dual role as behavioural co-ordination signals, and experientially represented objects.

The study suggests a substantive basis for deriving an approach to semantic and cognitive theory in terms of experiential content, and thereby contributes to a significant strand in recent cognitive science and philosophy which emphasises the priority of experiential content in deriving cognitive accounts.

## 12.2 Limits of the Study

The scope of the study is restricted in a number of respects, which place limitations on the conclusions drawn, or the contexts in which they can be applied or to which they can be extrapolated. These can be broadly grouped according to their source (the context for the product semantic approach; the content of product semantic accounts; the methodology adopted in the study) and can be summarised as follows :-

### *Limits of Context*

- a) At the outset of the study a distinction was made between the content and scope of product semantics as presented, and assumptions regarding its content and scope that may in fact have motivated its use by others. The central concern of the study was identified with the substantive proposals represented in the product semantic position, on the grounds that an analysis and clarification of the framework would be of value per se, and would also provide the basis for a deeper understanding of the comparative conceptual position relating to the various ways in which it has been applied. The study has not attempted to comprehend the perceptions of product semantics that have motivated such applications, and the conclusions drawn cannot therefore be extrapolated to these contexts, without a separate analysis of their basis.
- b) Similarly, a distinction was made between the substantive content of product semantic accounts and the more general ideological stance and polemical form in terms of which the position is sometimes presented. It was argued that it is generally possible to establish substantive content in the face of polemical presentation, and that with the exception of some aspects of the role of mediation in meaning-making (which were separately discussed) the analysis of content could therefore be uniformly addressed. Although this is the case, it is also possible to take the view that it is the broad ideological stance (rather than the detailed substantive content) that constitutes the basis of its more general reception, understanding and application. The study does not directly address the ideological stance represented, and the arguments and conclusions are restricted to questions relating to the conceptual structure and substantive content of the proposal.
- c) The scope of the study is also self-limiting in respect of the fact that the core product semantic position is established by its proponents in relation to a conception of products and product design. In practice, the conceptual framework has been extended to encompass other spheres of activity, notably graphic and communication design. In these contexts the product semantic approach has a closer affiliation with semiotics and aspects of communication theory which centralise issues relating to the idea of symbolism and



interpretation, to the extent that they can be argued to constitute a separate stance. The scope of the present study is restricted by the acceptance of the broad conception of 'product' which underlies the core of the product semantic position established by its originators and in terms of which the framework is articulated, and it cannot be assumed that the arguments or conclusions will transpose successfully to these extended contexts without separate analysis.

### *Limits of Content*

e) In establishing a critical position as part of the basis for developing an account of user-interaction, product semantic accounts address questions relating to design theory in terms of a 'prevailing model' or 'paradigm', which is taken to represent the philosophical and theoretical commitment prevalent in current design practice and theory. This is primarily used as a foil for establishing the terms of a product semantic account, rather than a sustained attempt to represent the range and content of current theory. The present study therefore does not consider the veracity of this model separately or directly, but only in respect of the derived substantive product semantic proposal. In addition, where design models drawn from alternative theoretical positions are introduced, their role is to assist in clarifying either the product semantic stance or the nature of concepts deployed. The study should not therefore be taken to be promoting the authenticity or viability of the design models so introduced, nor that the arguments or conclusions are to be applied in the conceptual assessment of design models external to the product semantic framework.

f) The product semantic argument, in so far as it is intended to be deployed in arriving at a design stance, essentially comprises two steps. Firstly it argues for a semantic and cognitive account of user-interaction which is intended to underpin the creation of user-product interfaces (identified as the core design activity in the case of product design). Secondly it asserts that an effective design process and its associated methodologies involves the possession and deployment of these semantic and cognitive models of user-interaction. Although a broad range of methodological commitments are identified in product semantic accounts, the links with semantic and cognitive models are not clearly established. The detail of product semantic accounts is in practice limited to the first part of the argument, whilst the form of their implementation as elements of a conception of the design process (represented in the second part) remains relatively undeveloped. The direct consideration of the nature of the design process and related methodological issues within the present study is therefore restricted to the form, and at the level of detail, in which they are represented in product semantic accounts.

### ***Methodological Limits***

- g) In this study product semantics is generally treated as a single unified framework which is informed by a number of distinct but related accounts. The justification for the underlying assumption is that the accounts are cross-referring, and bound by their common commitment to a broad conceptual approach and the use of a number of key articulating concepts. Nevertheless, it is recognised that there are distinctions to be made between the approaches represented in individual accounts and these are identified where possible in the analysis, in respect of the principal contributors.
- h) The product semantic framework is in general established indirectly by its proponents through the choice and exposition of concepts and their relations, rather than directly as an explicitly characterised whole, and the majority of accounts deal only with restricted parts of the framework. Although there is no single locus for the systematic exposition of the framework as whole, two accounts in particular (those of Krippendorff and Vihma) provide a broad overview for the location of concepts, and the substance for the identification of an overall explanatory argument structure, to which the other accounts can be assimilated. In addition, the characterisation of concepts and relations in product semantic accounts is often informal rather than formal, and expounded by adverting to their content relative to their use in established theoretical areas (or by metaphorical extension from such areas). These several aspects of the matter and form of the available material have shaped the study methodologically, particularly in the need to adopt a reconstructive approach to the analysis of concepts (which are derived by inference from the references adverted to in product semantic accounts), and an inferential approach to deriving an explanatory structure. Since the approach is reconstructive and inferential, it is not possible to read the detailed content of the arguments and the conclusions directly back into the individual product semantic accounts from which they are drawn, without sensitivity to the context in which they are presented.
- i) The assessment of the framework is restricted to considerations relating to conceptual structure and conceptual viability, and the arguments and conclusions cannot be extended directly to design practice. Product semantic accounts (and the available related literature) remain insufficient to support a general assessment of the utility of the framework in the context of practice, for two principal reasons. Firstly the empirical content of the few reported applications are neither systematically enough presented nor sufficiently detailed to support such analysis. Secondly the reported applications are not sufficiently correlated with the conceptual framework presented in product semantic accounts, for empirical results to be used in assessing the practical utility of the framework.

### 12.3 Directions for Further Research

The product semantic framework represents an initial attempt to develop a comprehensive explanatory account of user-product interaction, which extends from the socio-cultural sphere to the level of individual cognitive functioning. In order to achieve a viable explanatory structure some re-orientation of the framework is necessary, the implications of which were considered in respect of - semantic theory and cognition, and design theory and methodology - to which the principal indications for further research relate.

#### *Semantic Theory and Cognition*

- a) In relation to the possibilities indicated in the study for an experiential approach to semantics and cognition, a strategy in the philosophy of mind is suggested which is centred on the idea of judgement in action, and which approximates to a cognitive implementation in terms of a core 'simulation' model rather than a 'planning' model. Expressed in terms of philosophical meaning theory, it also supports the possibility of a reconciliation between folk-psychological (intention-based) and truth-conditional accounts of meaning. One major area for further research would consist in fleshing out these proposals more formally and completely. This might be approached by expanding the core context for the characterisation of meaning from a linguistic context to the broader context of action, and expressing its foundational content in terms of non-propositional rather than propositional forms (eg de facto 'acceptance' rather than 'belief').
- b) A parallel approach in the field of cognitive science would suggest centralising the idea of embodiment in models of cognition and giving priority to the role of action in accounts of cognitive functioning and development. In this respect, the role of 'affordance' is central to the programme. In the form of basic affordance and in the context of a relational account of function and a teleological semantics, the concept offers an outline model for the 'naturalisation' of content, and an emergent view of supervenience relations. A second major area for further research would consist in establishing the detail of the account in the context of connectionist or dynamic systems approaches to cognitive theory.
- c) The study suggests that cultural production is conceived as occupying the interactive space between meaning hierarchies (affordance hierarchy and co-ordination hierarchy), offering a substantive context for realising the product semantic aim of linking individual product significance with cultural expression. A further area for research would consist in shaping the proposal in terms of the role of external 'symbols' in cognitive development, and relating this to the more general accounts of artefacts and cultural production. This theme could be pursued in parallel in the context of the development of design theory.

### *Design Theory and Methodology*

- d) In addition to the above proposal (c) which represents the most radical theoretical move in conceiving products formally as external aspects of cognitive functioning, the principal areas indicated for further research relate to possibilities for augmenting product semantic conceptions of the product space. The product semantic approach proposes an ecological conception of products as one basis for developing semantically organised design theories (which are primarily articulated categorially in terms of the correlation between type-identity and attributes). The study suggests that the conception of a product ecology could be further developed as a multi-dimensional space, whose additional dimensions would draw in the second conception of product ecology (products as traits or attributes). This could be approached, for example, by co-mapping product-space parsings based on transparency/opacity and attributive models, to the existing prototype semantic categorial model, and would depend on initial research into the structure of attributive terms and their relation, for example, to conceptions of product 'character'.
- e) The technique of multi-dimensional scaling has been successfully applied in respect of the relationship between qualitative attribution and formal content in very restricted product domains. One avenue for methodological research, would consist in exploring ways in which the approach could be generalised across broader product domains. The suggestion drawn from the theoretical model is that the key to this rests on a richer and more comprehensive understanding of the product space and its articulation from a user perspective. This might initially be approached on the basis of a multi-dimensional product space model as noted above (d).
- f) The product semantic critique identifies key areas for methodological development which are not drawn into the framework (eg applying operational and ethnological methods to user-interaction). There are two areas for research which would begin to address this. Firstly the study proposes a central role for mediating structures in the interactive hierarchy, in the form of schemas. These are conceived along the lines of the contextual and action schemas familiar in cognitive science and in the characterisation of expert performance. In terms of the framework they are operative at a level below that associated with conceptual organisation articulated through language and explicit representation, and represent the form in which underlying experiential content is organised. In order to unpack user-interaction operationally in product semantic terms, it would be necessary to clarify the relationship between verbal protocols (and protocol analysis) and user models analysed in terms of action patterns. Secondly, in order to implement an ethnological approach, parallel research would need to be undertaken to establish the socio-cultural basis or contextualisation of core operational schemas.

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## Appendix A Framework Models

There are a number of possible approaches to the analysis of theoretical and conceptual frameworks, each offering distinct perspectives on the basis for the characterisation of their nature and constitution. Four examples are of particular relevance to the product semantic conception in providing a continuum from a relational categorial account, to a meta-sociological account :- a) analysis in terms of the idea of a 'categorial framework'; b) analysis in terms of the concept of an 'explanatory structure'; c) analysis in terms of 'paradigm' concepts; d) analysis using a 'habitus' concept.<sup>1</sup> Each provides a perspective on the nature of, and interaction between, the elements of relatively integrated systems of thought (and action) at the various levels of concreteness and abstraction that characterise them. They differ markedly in their implementation, both in terms of degree of formality and conceptual content, and in the degree to which they are concerned with the genesis of their constituent elements.

### *Categorial Frameworks*

There is clearly a fundamental connectedness between the various aspects of any system of practical and theoretical thinking, which will for example involve elements such as the way in which things are classified and the principles governing classification, the logic underlying thinking, and the metaphysical beliefs held. Taken together, the particular stance taken in respect of these (and other) elements can be viewed as comprising a framework which characterises a broad theoretical position. The choice and prioritisation of the elements that are perceived to most appropriately capture a system is clearly a matter of debate and to some degree marks out the differences between kinds of theory associated with particular disciplines, although there is considerable consensus in respect of the choice of elements that are regarded as essential. Given that product semantics rests substantially on a categorisation model, it is perhaps natural to focus first on an analytic scheme in which the concept of categorisation plays a leading role.

Korner argues for the primacy of a characterisation which links - a) a fundamental classification of entities (with reference to the distinction between arbitrary classes and natural kinds); b) the relationships that hold between primary categories (or maximal

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<sup>1</sup> The concept of a 'categorial framework' developed here will be substantially based on the model provided by Korner and elaborated in Korner [1970]. The concept of 'paradigm' used here is that employed by Kuhn in his classic work on the structure of scientific revolutions. [Kuhn 1970]. The interpretation of Kuhn's sense (senses) of 'paradigm' is consonant with the general conclusions reached by Masterman in her overview and analysis of his use of the concept. [Masterman 1970]. The concept of an 'explanatory structure' which in some ways overlaps with and connects categorial frameworks and paradigms, is based on the notion expounded by Gaukroger in the context of exploring concepts of explanation in early physics and philosophy. [Gaukroger 1978]. The concept of 'habitus' is taken from Bourdieu, as elaborated in two key works which explore the definitions and relationship of theory and practice. [Bourdieu 1977,1992].

kinds) and between maximal kinds and subordinate categories; c) the nature and criteria for membership of a maximal kind; and d) the logical assumptions underlying categorisation, categorial constitution and individuation.

The assumption, on the basis of evidence from linguistics, psychology and anthropology, is that there are a variety of ways in which the world of experience is differentiated, and in addition that there are many ways in which the totality of what is discerned can be classified. A total classification partitions all objects into a finite set of non-empty exclusive classes, which may be sub-classified on the same basis a finite number of times. Although there is no in-principle constraint on the constitution of categories and their hierarchical ordering, some classifications seem more natural than others, to their users. The perception of what constitutes a natural classification rests to a great extent on three types of distinction which such a classification is held to satisfy for its users - a) the logical distinction between objects that are ultimate and those that are not - objects which possess characteristics but are not themselves characteristics and objects which both are, and possess, characteristics; b) the ontological distinction between objects which are fundamental and those which are not - objects which exist independently of other objects and those that do not; c) the psychological distinction between objects which are co-ordinate and those which are disparate - objects which belong together and those which do not. A natural classification is one which in the eyes of its users respects their interpretation or implementation of these three kinds of distinction.

The formal distinctions pursued by Korner are principally related to the higher levels of a total classification in order to yield a principled and systematic basis for demarcating distinct philosophical positions, and as such need not concern us at this point.<sup>2</sup> Instead we will consider aspects of the relationship between different kinds of reasoning, and their relationship to the structure of categorial frameworks. The principal distinctions here concern on the one hand constructive and factual thinking, and on the other common sense and scientific (theoretical) thinking.

The distinction between 'factual' thinking (thinking in respect of existant and unalterable states of affairs) and 'constructive' thinking (thinking in respect of alternative expectable, practicable or optional states of affairs) can be expressed in terms of the difference between branching and branchless sequences. If we define a 'situation' as a conjunction of characteristics characterising a region of space during an interval of time, the specified

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<sup>2</sup> Korner's analysis is pursued on the basis of identifying the phasing of the higher levels of a total classification in terms of the partitioning of objects into dependent and independent particulars and attributes and equating these with the instantiation of maximal kinds. Maximal kind categorisation is examined logically in terms of the primary and auxiliary functions of logics L and I (L is equivalent to classical logic and I to intuitionist or standard modal logic) and their extensions L\* and I\* (which accomodate inexact propositions). [Korner 1974, pp 4-10].

content of which is regarded as an information set, and a 'sequence' as a succession of situations, then there two distinct modes in which a sequence can develop. The development of any sequence will involve the enlarging of the information set, every information set including and enlarging its predecessors. However in some developments an initial or intermediate situation may be the initial situation for at least two different sequences. Such sequences can be termed 'branching' and represented in the form of tree diagrams.

The logic of constructive thinking is characterised by thinking in terms of branching sequences, which in turn is captured by the logic I. The structure of practical thinking is underpinned by the constructive, in the sense that it is also characterisable in terms of the logic I, although it is subject to additional constraints regarding branching conditions. Clearly practical thinking is concerned with the exercise of options, and representable by trees consisting of optional sequences of situations. It is also the case that if a situation is optional, then it is also practicable, and if it is practicable then it is also empirically possible. The domain of empirically possible developments is demarcated by the empirical beliefs of the agent and the sequence should therefore be such as not to contravene such beliefs. This is distinct from practicability, which although subject to the same requirement in respect of the consistency of branching with empirical beliefs, is additionally subject to the requirement that there are additional factors, equivalent to the existence of particular kinds of internodal sets which postulate intermediate conditions which if they obtained would support the belief of the agent that passage from one node to the next was possible.

Korner further distinguishes between 'commonsense' and 'theoretical' thinking on the basis of differences in their logical and categorial structure.<sup>3</sup> The distinctive, though not exclusive, characteristics of theoretical thinking, particularly as exemplified in scientific thinking consist of mathematization, deductive abstraction and theoretical innovation. In mathematisation, particulars in any partitioning into maximal kinds, are associated with quantities and their relations taken to be isomorphic with mathematical entities such as numbers.<sup>4</sup> This is seldom possible in the case of commonsense thinking, where the attributes of particulars are typically inexact. A mathematised system of particulars and their relations yields a transparent theoretical structure which is unambiguous and

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<sup>3</sup> Korner pursues the analysis in terms of the logical and epistemological requirements for axiomatisation, concluding that there is no logical difference, or difference in categorial structure inherent in the axiomatic non-axiomatic distinction, but rather that the difference is reflected in the different arrangements of premisses and conclusions in formal argument. Where sufficient precision can be obtained in respect of the exactness of attributes, which is particularly the case in scientific contexts such as classical physics, then formal axiomatisation becomes possible.

<sup>4</sup> Although this presupposes the availability of mathematical theories and therefore maximal kinds of mathematical particulars, it does not require that these are accorded any particular ontological status.



susceptible to axiomatisation. However the unambiguity and transparency of the result is in fact gained at the expense of increased distance from commonsense experience and thinking, involving for example, radical idealisation. Characteristically this involves substituting phases or metric elements for continuous processes or regions.<sup>5</sup>

Although deductive abstraction can thus be viewed as a tightening of the commonsense view which is accompanied by a loss of information, in so doing it increases the possibility of theoretical innovation. In classical dynamics the concept of a particle can be regarded as providing an example of the results of such a process. In one sense it can be seen as the limiting case of the concept of material objects, which can possess attributes such as position, extension, momentum, temperature and colour, but which in terms of the idealisation associated with deductive systematisation is conceived as having only position and momentum. The upshot is the disjunction between the description of observations and experiment and the idealisations embodied in the state descriptions of deductively structured theory.

The state descriptions of theory and the commonsense descriptions of observation can be viewed as expressions in different languages - the natural language having been subject to modification to yield the formal language - and as such it could be argued that some degree of equivalence can be re-established.<sup>6</sup> The limits of such partial equivalence are ultimately an empirical matter to be settled, at least at the instrumental level, through an evaluation of the success of attempts at prediction, but are guided by the general principle of 'the negligibility of the neglected' - the requirement that if an empirical and an ideal statement are equated in some context, then the features or attributes neglected in making the equation should be negligible in that context.<sup>7</sup>

Typically, disciplines are 'double layered' in the sense that prediction or judgement of outcomes are made through such an identification of theoretical concepts and statements with corresponding commonsense statements. This is the case because in dealing with the central concept of equality they employ both the mathematical concept of equality which is

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<sup>5</sup> It has been argued that this substitution of digital for analogue forms of expression is essential to and characteristic or even constitutive of theoretical thinking. In one sense it can be seen to correspond with a process of categorisation, which is essential to successful reference. In the context of a theory of communication and information, Dretske has argued that it forms the essential basis of the distinction between information and knowledge and therefore fundamental to the ideas of cognition and reasoning.[Dretske 1981].

<sup>6</sup> Komer argues that this is the case, but that it cannot amount to a recognition of identity of expressions in formal languages with those of the natural languages from which they are derived, but only a conditional identity within limited contexts. [Komer1970, p 47]. However it is by no means clear that the matter is so easily resolved since in many cases the innovative theoretical constructs that arise from the process of idealisation and abstraction remain distinct from commonsense concepts, to the extent that they have been perceived to pose questions regarding the limits of conceptualisation.[See for example Mellor 1969; Capek 1961]

<sup>7</sup> This is equivalent to the expression of the minimal demands of rationality in explanation [Hughes 1976]

transitive and the notion of perceptual equality which is non-transitive. Similar logical differences occur in the descriptive and taxonomic aspects of disciplines, where there is a distinction between strictly applied formal classifications and commonsense classifications.<sup>8</sup>

The necessary co-existence of commonsense and theoretical statements in the practice of science and other disciplines raises the question of both logical and ontological primacy, since the logic and constitution of the maximal kinds of commonsense thinking need not be (and in fact seldom are) the same as the logic and constitution of the maximal kinds arrived at via theoretical thinking. The question of which should be regarded as primary and which secondary is an open one, as was the case with the relative status of constructive and factual thinking, each answer representing a different epistemological commitment.<sup>9</sup> The interaction between commonsense and theoretical modes takes the form of a reciprocal interchange in which the transposition of each to the mode of the other carries with it the logical constraints of the mode to which it is transposed. The effect of the interchange, in addition to allowing for logical clarification in one direction and expression of prediction in the other, is to create continuous modification to the conceptual basis of both commonsense and theoretical modes through their mutual adjustment.

Korner's account is determinedly rooted in an objectivist approach to the analysis of frameworks of thinking, and expresses the distinctions between 'factual' and 'constructive' thinking, and 'commonsense' and 'theoretical' thinking in terms of their distinctive abstract logics. Given this background, particular theoretical frameworks are distinguished in terms of their ontologies and categorial principles. The different modes of thinking, which are operative to different degrees in all frameworks, are interactive in the implementation of a framework as an overall theoretical and practical approach. Although there is this expression of continuity and mutual re-definition between kinds of thinking, all are expressed in terms of the highest levels of abstraction attainable, and worked out as consequences at lower levels. The principal criticism aimed at approaches of this kind, derives from attempts to match their implications with descriptions of

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<sup>8</sup> Korner identifies the property of 'double-layeredness' with scientific disciplines (including most of the social sciences). He does not regard history, morality or religion as double layered and in the context of his overall distinction between commonsense and theoretical thinking, cannot credit these disciplines as generating true theory. The basis for this is that these disciplines have no use for simplified ideal world models, but are essentially descriptive. There does not seem to be a principled reason in support of this standpoint since the use of models or abstractions of one kind or another are common to all disciplines.

<sup>9</sup> Korner cites the example of Plato and Descartes who held that definiteness and distinctness are necessary conditions of genuine knowledge, and that therefore perceptual propositions (expressed in terms of 'starred' logics) are merely a prelude to fully rational propositions (expressed in an 'unstarred logic'). This is contrasted with the position of Locke and other empiricists whose prototype of knowledge is perceptual (expressed in a starred logic), and for whom all other forms of knowledge are parasitic on perceptual knowledge. [Korner 1970, pp 48-49].

practice in particular fields. At this level it is by no means clear that the nature of conceptual interaction is adequately captured by an objectively expressed abstraction of this kind, which falls short particularly in respect of the need to characterise the nature of conceptual and theoretical change, and to arbitrate between the applicability of different theoretical positions. This shortfall has been addressed principally in the form of attempts to articulate framework models from the perspective of practice and its history. The most familiar of these, which can in this context stand as an example for the approach, is Kuhn's expression of the structure of change in science in terms of the idea of a 'paradigm'.

### *Paradigms*

The classic philosophical notion of a paradigm was first articulated by Kuhn as part of an attempt to sustain a novel view of the historical and philosophical development of science, which aimed to do justice to the reality of scientific practice and to provide a picture of the nature of change and theoretical development within that broad field. The extent to which the resulting picture is judged to be either faithful or illuminating remains controversial, but need not be pursued here.<sup>10</sup> Our present concern will be largely confined to the concept of a paradigm per se and its applicability in characterising frameworks of activity.

Although the presentation of the concept is notoriously complex, there is nonetheless considerable agreement in respect of its key components. These are taken to be a) a 'sociological' component, b) a 'metaphysical' component, and c) an 'artefact' or 'construct' component.<sup>11</sup> In its sociological aspect a paradigm is an accepted set of habits acknowledged by a community as providing the foundation for its continued practice. In the context of science, and more generally, these 'habits' are constituted by acknowledged concrete achievements which have the dual characteristic of being relatively unprecedented, and relatively open ended. They are also conceived as pre-theoretic. The metaphysical aspect is less easy to define, but predictably includes equating a paradigm with a set of beliefs, and organising principles of various kinds (including 'myths' and 'maps'). The third aspect suggests that a paradigm operates as a concrete analogy or metaphor providing operational tools which underpin practice. In these senses it is clearly compatible with the view of the role of models relative to frameworks, developed above.<sup>12</sup>

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<sup>10</sup> For example, the question of whether the history of science is accurately characterised in terms of successive periods of 'normal science' and 'revolutionary science', or whether, for example, Lakatos' model of their co-presence provides a better picture.

<sup>11</sup> Masterman, in her discussion of the nature of Kuhn's paradigms, describes these as though they might be separate conceptions of a paradigm. It is unclear from her analysis to what extent this view is expected to be taken literally, but clear that the central component or conception relates to 'constructs'. [Masterman 1970]. I will take Kuhn to be implying that they are co-present aspects of what constitutes a paradigm.

<sup>12</sup> Section 1.4 'Frameworks, Theories, Models'.

A paradigm is that concatenation of beliefs, assumptions and accepted working practices that characterise a discipline in action. At one level it constitutes the way in which the unfamiliar is made familiar, by providing the framework within which all new experience related to a discipline can be assimilated and accounted for. In linguistics the term paradigm is used in a narrower but closely related sense to refer to recurring patterns of rules among particular groups of words which give systematic meaning to particular instances, and for which one selected instance of the pattern serves as an exemplar for the general expression of the rule (such as verb endings in latin, exemplified by the conjugation 'amo, amas, amat....etc). The paradigm functions by licensing the replication of examples, and in principle all instances of the pattern so generated are equivalent in their potential as exemplars.<sup>13</sup> Although something like this sense is in part preserved in Kuhn's conception of a paradigm, it also carries with it the reciprocal concept of accumulated case law, through which the articulation of a rule or practice is given shape and meaning in the light of the vagaries of the range of concrete instances that arise.

The paradigm concept is a complex which can be conceived as operating at a number of distinct levels which form a loose inclusive hierarchy. The highest and most inclusive level comprises the sociological aspect, which draws in all the components involved in the implicit acceptance of 'ways of looking at things' and 'ways of doing things' by a community of people engaged in the practice of a discipline that they hold in common. These typically take the form of the 'habits' which develop and are transmitted as concrete professional models and standards of acceptable practice. In a narrower sense a paradigm in the sociological sense is equated with accepted methodology, and can often take a form which is pre-theoretic.

At the next level, that of paradigm as 'artefact' or 'construct', method or practice in a discipline is located in the concrete sources for 'puzzle-solving' activity. Some sense of this articulation, which is the core of the Kuhnian paradigm underpinning normal science, can be gained by thinking of it in terms of a mechanical procedure for achieving a predictable outcome - the form of an algorithm, or the pattern of inference in a hypothetico-deductive system. But whilst it can be argued that there is a strong parallel here,<sup>14</sup> Kuhn emphasises the concreteness of this sense of paradigm. It would therefore be more in tune with his exposition to think of a paradigm in this sense as a concrete analogy - the application of a picture of a known artefact or construct, to new material. This idea comes very close to the notion of the role of models developed earlier, and has a parallel function in Kuhn's view of the development of a more metaphysically explicit and

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<sup>13</sup> Kuhn 1970, p 23.

<sup>14</sup> Masterman 1970, p76.

theoretical perspective.

At the metaphysical level, the concrete analogy applied to new material sets up a 'way of seeing' the new material - a descriptive and analytical structure which is transferred in dealing with it, which when detached from its source can be operationally re-interpreted in the terms appropriate to the new material.<sup>15</sup>

This view of a 'paradigm' can in one sense be interpreted as inverting the traditional hierarchical model, which runs from a broad and inclusive metaphysically characterised worldview, via interpretation in the form of models, down to the specific practices of a discipline. But although this would appear to be the case, it is also possible to regard the distinction in approaches as representing different perspectives, one emphasising the top down elements of the structure, the other emphasising the bottom-up elements. However, the limits to a perspectival view of these approaches is set by the different order of inclusiveness of the levels in the hierarchy that they each represent, and to this extent they are on the face of it logically incompatible. The reality and extent of the apparent logical incompatibility could in principle be explored via the central level, which is the articulation point for the theory-practice interface in both hierarchies, and the closest approximation to this is represented in Gaukroger's use of 'explanatory structures' as an analytical tool.

### *Explanatory Structures*

Korner's treatment of frameworks in terms of categorisation represents one extreme of a continuum running from the formal analysis of relational structures, to the other extreme represented by Kuhn, where frameworks (paradigms) are viewed as approximate pictures underpinning the commitment of a community to its accepted goals and forms of normal working practice. The contrast of the extremes lies in the respective importance given to either the abstract formal expression of the entailments in a network ultimately conceived as objectively separate from practice, or the nature, development and mode of change in the forms of normal working practice themselves. But clearly some form of relational conceptual structure is implied by the nature of working practices as expressed in terms of a paradigm, and working practices of some kind assumed to pre-figure a given categorial structure, in spite of the apparent conceptual distance between them. Some analysts have narrowed the conceptual distance by suggesting that frameworks or discourses can be characterised in terms of conceptual structures that lie closer to the practice of disciplines than the metaphysics of category hierarchies for scientific or commonsense thinking.

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<sup>15</sup> Masterman cites the example of the genetic code, whose initial analogy consisted of a 'picture' of language (which includes 'letters', 'words', 'sentences' and 'punctuation'), but which is now operationally redefined in terms of biochemical terms and procedures, and constitutes an independent model. [Masterman 1970, pp 78-79].

An approach to the consideration of frameworks or discourses, which implements this suggestion, is represented in Gaukroger's analysis in terms of explanatory structures.<sup>16</sup> In his approach to questions surrounding the conceptualisation and assessment of explanations in science, Gaukroger defines a theoretical discourse as any unified set of articulated theories.<sup>17</sup> Discourses can be classified in a whole range of ways, for example, topically, developmentally or formally and do not exist in isolation but rather in particular 'social' contexts which can be variously described, for example, in cultural, economic and political terms. In principle there are an indefinite number of factors that bear on the constitution of theoretical discourses, and it is therefore a major problem to determine a non-arbitrary basis for the selection of just those factors that are relevant in the characterisation and comparison of discourses. Kuhn's differentiation of discourses in terms of paradigms is considered flawed precisely because it runs the principles together in the form of an imprecisely analysed composite conception, and in particular because it fails to distinguish between atemporal and ahistorical epistemological issues and sociologically rooted developmental issues that are essentially etiological and historical. In order to characterise and assess a discourse, Gaukroger argues that it is necessary to distinguish between the question of how an explanatory structure is constituted, and the question of how it functions once constituted.<sup>18</sup>

If we distinguish the epistemological components of a paradigm then we approximate to an explanatory structure, and the explanatory structure of a theoretical discourse is that framework which determines what counts as an explanation in that discourse. The proposition then is that theoretical discourses are to be differentiated in terms of their explanatory structures, which in turn are constituted by theories - statements or sets of statements that are used in explanation. Explanations are given in terms of a set of entities framed by the explanatory structure and underpinned by a fundamental set of entities which are irreducible within the discourse. The irreducible set constitutes the ontology of the discourse, and in explanatory contexts, is linked to a set of phenomena - the domain of evidence - which constitutes the evidential content of the discourse. The actual nature of the evidence will vary with the discourse, but the explanatory structure provides criteria in respect of a domain of evidence for what can be counted as evidence. The ontology and the evidential domain are linked in an explanatory structure by the system of concepts of the discourse and a proof structure which defines the relations and inferences that hold between statements in the discourse. An explanatory structure thus consists of a number of general features comprising :

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<sup>16</sup> Gaukroger 1978

<sup>17</sup> A theory is '...anything which is, or can be, articulated in the form of a statement or set of statements, which purport to offer, or which can be taken as offering, an explanation of something.' [Gaukroger 1978, p3].

<sup>18</sup> Gaukroger does not deny that these questions are equally important, but argues that in order to deal with them adequately it is essential that they are kept distinct.

**'an ontology, a domain of evidence, a system of concepts which relate the two, and a proof structure which specifies the valid relations which can hold between the concepts of this system.'**

Comparison of explanations in different discourses depends on them being explanations of the same thing. The difference between disciplines is generally marked out in terms of the case where there is no overlap between domains of investigation, and where therefore there is no comparative explanatory basis. 'Sameness' in explanatory terms is problematic in two respects, both related to the general philosophical problem of stability of reference. In the first place a theory refers to the phenomena which are being explained, in the second it can be said to refer to the entities from the evidential domain which it invokes in explanation. In both cases problems arise in establishing continuity of reference for terms designating evidence, since in comparing explanatory contexts there is no guarantee that what is referred to by terms has the same sense or meaning. In two different conceptual frameworks a term may apparently have the same reference but carry a different sense in relation to the conceptual content of each framework. The problem is less acute in the case of domains of investigation, since the sense/reference distinction does not preclude an overlap between the extensions of such domains. Nevertheless stability of reference cannot be guaranteed, but only established after investigation.

The fundamental set of entities in terms of which explanations are given constitutes the ontology, whilst the domain of evidence is the set of phenomena which could confirm, establish or refute purported explanations. Entities are comparable to the degree that the same predicates can be applied to them, and their classification into kinds is conventional in the sense that any predicate can be used to demarcate a kind. However, in particular discourses, classification and individuation is not arbitrary since only selected predicates will be used to classify entities into kinds. The primary kinds in a classification are those where the entities that are members of the kind are independent (irreducible to one another or to other kinds). All explanations in a discourse can be given in terms of primary kinds or entities reducible to primary kinds.

A key issue in relation to the ontology of a discourse concerns the status of the entities that it invokes, relative to the ontology of sense experience. Traditionally a distinction has been maintained between the theoretical and observation terms of a language, construing observation terms as unproblematic and requiring that theoretical terms be explained by reference to observation terms. There are entities that can routinely be observed and others that cannot be observed but which are nonetheless asserted to be part of the ontology and used in explanation. However it does seem clear that observation itself involves conceptualisation, particularly in the form of shared classification which is required for

successful ostension or demonstrative reference, even if it is difficult to regard commonsense observation as theoretical. The issue is whether all existential statements are theoretical, commonsense or not, given that they all involve conceptualisation.

The upshot of Gaukroger's consideration of these issues is that statements of this kind are not purely observational, since they depend on concepts, but this does not render them theoretical since they serve functions other than explanation. It is inappropriate to ask for evidence in respect of such statements, but reciprocally they have no explanatory value. The status of statements *per se* is essentially context relative, and may be theoretical in one context and atheoretical in another. In respect of ontologies, the existence of kinds of entity can only be established within a particular ontology, and is dependent on the coherence of kinds constituting the ontology as a whole.<sup>19</sup>

The constraints on acceptable explanation within a discourse are provided both by the ontology which circumscribes the range of entities in terms of which explanations can be given, and the domain of evidence which encompasses those situations which can count as evidential in determining, for example, the forms in which explanations can be given. The domain of evidence includes both what actually does count as evidence, in the sense of the evidence which we do have access to, and also what could count as evidence although we do not have access to it. In many cases the domain of evidence will include inaccessible evidence, for example in the form of idealisations which cannot be met. In these cases, a conceptual link is made between the idealisation used in explanation and a parametrically comparable case to which we have access in the domain of evidence.<sup>20</sup> The system of concepts and the proof structure which establishes the constraints on the relations that can hold between concepts, together provide the link between the ontology of the discourse and its domain of evidence.

The development of a theoretical discourse is ultimately related to the framing of a field of investigation which expresses our interests in systematically addressing certain kinds of problem, and the specification of constraints on what would count as acceptable explanations for phenomena within that problem field. The ontology of a discourse, on the one hand frames the criteria for the appropriateness of explanations, whilst on the other, the domain of evidence frames the criteria for the adequacy of explanations. Explanations are proposed in terms of an ontology and with reference to a domain of evidence, and the means by which the accounts given in explanations are related to evidence are constituted by the system of concepts of the discourse. The allowable inferential relations operative within the system are conceived as the proof structure of the

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<sup>19</sup> An ontology is not just any mixture of existent kinds, but a set of relationships between kinds of thing relative to irreducible kinds. In this sense it is not arbitrary but depends on 'completeness' and 'coherence'.

<sup>20</sup> For example in the case 'perfect' gases, or free fall in a 'complete' vacuum.



discourse. The particular form taken by the elements of an explanatory framework are interrelated and may be interdefining, in the sense that a change in one part of the framework may require changes to the remaining elements. An explanatory framework is an instrumental notion, in the sense that it is relativised to the aims of a discourse and its domain of investigation.

The concept of an explanatory structure is clearly related to that of a categorial framework, but whereas the articulation of the latter is geared to the relationship between logic and categorisation in the characterisation of broad philosophical positions, explanatory structures provide conceptual criteria for the comparison of theoretical discourses at the level of the practice of disciplines. In terms of the contraposed hierarchies used to compare the categorial and paradigmatic conceptions considered above, 'explanatory frameworks' articulate discourses in terms of the commonly held middle level where the theory-model relation is a central issue. In this case however this relation is not approached directly, but in terms of the way in which discourses organise and provide criteria for the kinds of thing that count as explanatory, which are then expressed in terms of theoretical form and content. The basic idea is that frameworks expressed as discourses form themselves around conceptions of what is their proper subject matter, and what sorts of things count as evidence in explanation of them. The formalisation of these elements and their relations consists in the specification of an ontology which characterises the nature and limits of the subject matter, criteria for the evidential domain, and a system of concepts and an inferential structure which constitute the principal elements of the explanatory structure which links them. The conception lies close to a paradigmatic approach in the sense that subject matter and explanatory practice underpin the development of a metaphysical stance, and close to a categorial approach in the sense that the separation of epistemological elements and their specification in terms of ontologies and inference structures constitutes the developed form of a framework. The problem remains to assess the extent to which epistemological elements can be meaningfully separated from the contexts of practice and genesis in the characterisation of theoretical frameworks. Is Kuhn right in thinking that these are essential to understanding frameworks and the nature of the theories that they frame ?

### *The Logic of Practice - 'Habitus'*

The similarities between the analysis of theoretical frameworks in terms of categorial frameworks and in terms of explanatory structures will be apparent. Both employ distinctions in the ways in which logical, ontological and epistemological conditions can be met, and their interrelation, as the basis for distinguishing between different conceptual frameworks and theoretical positions. They differ both in the level of abstraction and

formalisation that are applied in making such distinctions, and in the priority given to the different terms of the analysis, although for both, the ontology of primary categories (maximal kinds) lies at the heart of such characterisation. There is a further consequential difference. Analysis in terms of categorial frameworks takes a neutral stance in respect of the purposes of theoretical discourse, in the sense that it is an analysis of the relations obtaining between the necessary components of any possible de facto world picture, conceived as independent from the context of its formation. The application and contextualisation of the framework in particular contexts, where these fall below the level of distinguishing between broad philosophical positions, are conceived as differences in the way the elements of a categorial framework are interpreted in a particular case. It therefore stands conceptually at a considerable distance from practice. Analysis in terms of explanatory structures, on the other hand, acknowledges contextuality relative to purpose and this is embodied in the active notion of explanation in terms of which it is underpinned. The aims of theoretical discourses are to account for and explain phenomena, and the appropriateness and adequacy of explanatory forms and particulars are matters which must be judged in terms of the standards of explanation that characterise particular theoretical discourses. Comparison can only be effective where there is a measure of agreement in what constitutes the domain of investigation - in the relative identity of that in respect of which an account is provided. There will in some cases therefore be a radical incommensurability between kinds of theoretical framework.

Kuhn's insight consists in the sense that frameworks of knowledge and belief cannot be objectified in terms of the radical abstraction involved in the kinds of logical systematisation represented in the various approaches obtaining in the traditional history and philosophy of science. The problems associated with stability of reference and the resistance of practice to the logic of falsifiability, underlie a sense of the discontinuity between logical and theoretical idealisation and the reality of scientific practice, and leads to a perception of the ultimate incommensurability between theoretical positions, yet preserving the possibility of ongoing scientific practice. Beneath the layer of high level conceptual shifts, there is a conservative and resistant core of practices embedded in the routine work of the community. In Kuhnian terms, this core is defended until the theoretical discontinuity is so great that it is unable to contain practice and its assumptions, and is then subject to a 'gestalt switch'. In terms of explanatory structures, this might be differently framed, in the sense that it is at the level of practice that the fault line occurs. Theoretical change is driven by the failure of explanation, and the consequent need to re-frame explanatory standards.

Although Kuhn's holistic and complex sense of a 'paradigm' is problematic because undifferentiated in logical, metaphysical and sociological terms, it nonetheless captures

something of the continuity between commonsense and scientific modes, and forcibly locates science as practice back into the context of the community in which it is engendered. In doing so, however, it conflates philosophical and sociological contexts and thus vitiates the aims of its programme. What then is the relationship between an abstract and ahistorically conceived sense of the concept of a theoretical framework, and an account conceived concretely and historically, and what are the consequences?

Responses to these questions can be framed in a number of ways, differing in the sense accorded to the idea of the habits or practices of a community. In the context of abstract categorial frameworks they are characterised as rule structures within the framework, whilst in the context of paradigms they constitute the psychological and sociological factors which establish patterns of practice underlying theoretical development.

I would argue that these positions are not incompatible. At the level of abstraction of a categorial framework, rule structures are the natural means for expressing the limits of rationality interpreted in the case of practice. Nevertheless, Kuhn is right in thinking that this form of expression cannot constitute an explanation of rationality, since it is internal to the abstraction.<sup>21</sup> But although Kuhn's insight, which I have presented as an inversion of the traditional inclusive hierarchical relationship, recognises this, his account falls short of a substantive alternative. If theoretical positions arise through the refinement and abstract expression of models derived from practice, then the logic of practice (if there is one) cannot be accounted for in terms of the metaphysics of theoretical positions, even though they can be expressed as relations within such positions. But if all that can be said about the 'habits' or 'practice' of a community is that they are psychologically and sociologically constituted, then we may not have moved very far forward. The deeper question concerns the relationship between the metaphysical/epistemological and the psychological/sociological, which are separated and isolated in both approaches.

Bourdieu locates the source of the problem in the artificial dichotomy set up in the distinction between 'subjectivism' and 'objectivism', which ignores the relationship of experiential meaning expressed through a kind of social phenomenology, to the objective meaning constructed in 'social physics' or 'objective semiology'.<sup>22</sup>

'Objectivism, which sets out to establish objective regularities (structures, laws, systems of relationships, etc.) independent of individual consciousnesses and wills, introduces a radical discontinuity between theoretical knowledge and practical knowledge, rejecting the more or less explicit representations with which the latter arms itself as 'rationalisations', 'pre-notions' or 'ideologies'.<sup>23</sup>

<sup>21</sup> This is Godel's proof in an informal version [Nagel and Newman 1959].

<sup>22</sup> Bourdieu 1977, 1992.

<sup>23</sup> Bourdieu 1992, p 26.

Bourdieu's conception of the relationship between theory and practice is rooted in the particular problems faced in the fields of anthropology and ethnomethodology. Whilst acknowledging the need for theory and associated abstraction, he raises a number of questions in respect of the basic precepts on which theory construction is carried out, and the consonance of such theory with practice. In pursuing such questions he arrives at a number of conceptions which have a bearing on the nature of a critical approach relevant to the consideration of theoretical frameworks for practices such as design.

The fundamental problem in characterising the theoretical structure of practical disciplines is contained in the misreading of the nature of practice which Bourdieu argues is inherent in the objectivist stance taken in the study of practice. The essence of practice cannot be expressed in terms of decoding the internal logic of a symbolism, but requires :

‘...restoring its practical necessity by relating it to the real conditions of its genesis, that is, to the conditions in which its functions, and the means it uses to attain them, are defined. It means, for example, reconstituting - by an operation of logical reconstruction which has nothing to do with an act of empathic projection - the significance and functions that agents in a determinate social formation can (and must) confer on determinate practice or experience, given the practical taxonomies which organise their perception.’<sup>24</sup>

The basis for this claim is rooted in the perceived failure of the various strategies of ‘objectivism’ to account for the real workings of practice. Such a failure is constituted primarily in the lack of a substantive distinction between the nature of explicit and tacit knowledge, and in the suppression of the temporal factors that in fact structure the logic of practical relations.

This is exemplified by Bourdieu, for example in the approaches taken to the concept of gift exchange in anthropology. Phenomenological approaches prioritise description in terms of the activities as experienced, and are structured in terms of the individual components into which it is parsed by its social embodiment - it gives priority to the commonsense accounts of the content and structure of social experience in the terms given by interpretations of the folk theory which has evolved to account for it. Structuralist accounts on the other hand posit a higher order principle, which cuts across the events of gift exchange as experienced and accounted for from within, regarding the totality of the exchange as a constructed object which constitutes the primary phenomenon. Thus the cycle of giving and receiving, which is temporal and experienced as felt obligation at ground level, is characterised in terms of the formal sets of relations exemplified in exchanges and the laws governing reciprocity.

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<sup>24</sup> Bourdieu 1977, p114.

The difficulty with these approaches highlights the general problem. On the one hand theory as a constructed object of theory, severs the relationship with experience and masks the factors which underlie the possibility of theory, whilst on the other, the conditions underlying the possibility of kinds of experience are hidden in the tacit assumptions of a socially constructed folk theory.<sup>25</sup> Any adequate account of theoretical frameworks must address this problem, which Bourdieu equates with the need to understand the workings of a 'logic of practice'.<sup>26</sup>

In effect, the idea is that the terms of reference of what counts as experience, observation, abstraction, objectivity, subjectivity (all the elements that structure the idea of perspective, a point of view, a way of seeing) are made in the context of 'practice', and cannot be rationalised in any way other than simply stating 'this is what we do'. Frameworks of thinking are retrospective constructions which rationalise history ahistorically, in the form of objectified sets of relations whose true nature and function are lost in the process.

'Nothing is more misleading than the illusion created by hindsight in which all the traces of a life, such as the works of an artist or the events at a biography, appear as the realisation of an essence that seems to pre-exist them. Just as a mature artistic style is not contained, like a seed, in an original inspiration but is continuously defined and redefined in the dialectic between the objectifying intention and the already objectified intention, so too the unity of meaning which, after the event, may seem to have preceded the acts and works announcing the final significance, retrospectively transforming the various stages of the temporal series into mere preparatory sketches, is constituted through the confrontation between questions that only exist in and for a mind armed with a particular type of schemes and the solution obtained through the application of these same schemes'.<sup>27</sup>

Different frameworks may thus bear very different kinds of relation to the practices and theories that they frame. Most familiarly they do refer to the kinds of structures that Bourdieu most objects to - representations of objectified epistemological and logical relations extracted from the contexts of their genesis and use, standing as the passive objective model for the rationality and legitimation of those active contexts. Alternatively they may represent the process of the transformation of practice into an objectified statement of the conditions for practice. Either way the nature of practice itself and its manner of creating objective structure is bypassed. This can be clearly seen for example in the prevalence of models of rational action and strategic planning as the underlying

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<sup>25</sup> The question which Bourdieu addresses in the context of an attempt to define a workable ethnomethodology, is at the centre of recent and current debates in cognitive science. One focus for the issue concerns the status of folk psychology relative to theories in cognitive science, and is expressed both in terms of the cognitive competences of individuals and their genesis in relation to social development, and in the literal or metaphorical interpretation of the idea of the computational mind.

<sup>26</sup> This is in effect an explicit recognition of the need to unpack Kuhn's notions of 'habits' and 'practices' which are unanalysed at the pre-theoretic conceptual level.

<sup>27</sup> Bourdieu 1990, p 55.

assumption of intentional theories of individual and collective action in psychology and sociology. In one sense this assumption and the assumption that collective action can be understood as a function of individual action, could be viewed as forms of idealisation comparable with the notion of ideal types in theories of physics, but in this case they are transcribed from the structures of a folk psychology constituted in an unanalysed social practice rather than the explicit manipulation of the dimensions of a property envelope in terms of an analysed relation of relevance.

Generalising, one might say that whilst at the explicitly conceptual level (the level at which concepts are recognised as being used, or are interpreted constructions of use) frameworks primarily express categorial or explanatory relations, at the level of practice (the level which operates in terms of the normative structures of commonsense thinking and action) frameworks primarily express the structuring principles operative through the constitution of individuals and social groups. The necessary continuity between them, which is brought out in Bourdieu's critique of objectivism, subsists in the ways in which the normative structures of practice, as forms and as functions, both construct and are constructed by categories, concepts and kinds of explanation.

The concept of 'habitus' by which Bourdieu attaches a name to these complex sets of reciprocal relations, belongs to the same family as the habits which form an essential part of Kuhn's conception of a paradigm. Like the mutual interaction between a rule and its interpretation in case law, 'habitus'

'...produces individual and collective practices.....in accordance with the schemes generated by history. It ensures the active presence of past histories, which, deposited in each organism in the form of schemes of perception, thought and action, tend to guarantee the 'correctness' of practices and their constancy over time, more reliably than all formal rules and explicit norms.'<sup>28</sup>

The source of the 'rule' is the mutual adjustment that takes place in the elements and assignments of social structures, which become embodied as norms and internalised as 'second nature', both individually and institutionally, and which persist through change in the form of structures that underlie the possibility of change. They are the 'genres' which frame modes of action and expression, and without which action and expression would not be possible or intelligible.<sup>29</sup>

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<sup>28</sup> Bourdieu 1990, p54.

<sup>29</sup> The active presence of past histories in the form of schemes of perception, thought and action, which Bourdieu locates in the shared heritage of a shared social place, are in other contexts interpreted as the structuring elements for conceptual schemes in cognition, for example 'frames', 'scripts' and 'schemas' in cognition, and narrative structures in folk psychology. The account also has a strong Wittgensteinian undercurrent, in the sense that there can be no external justification which underpins a rule, and therefore particular conceptual structure can only be underpinned by the de facto practices ('forms of life') of a community.

## Appendix B Theories of Emotion and Affective State

### *Approaches in Philosophical Psychology*

Although there are a wide variety of theories of the emotions, they can to some extent be viewed as variations on a small number of fundamental approaches. These might be broadly identified as theories that relate emotions to instincts or drives; theories that relate emotion to the perception of value; theories that view emotions as transformations in respect of the interface between a person and the environment; theories that view affective states generally as emergent properties of physiological states.

Historically the greater proportion of theories have taken the view that the emotions are essentially related to instincts, drives or motivation. The scene for one group of such theories was set by McDougall who characterised instincts as :-

‘...inherited or innate psychophysical disposition[s] which determine the possessor to perceive, and to pay attention to, objects of a certain class, to experience an emotional excitement of a certain quality upon perceiving an object, and to act in regard to it in a particular manner, or, at least, to experience an impulse to such action’<sup>1</sup>

Such dispositions are conceived as having conferred survival value, and thus to have been selected for in evolution, because of their role in the orientation of organisms to their environment. The mechanism involved comprises three parts, a central processing element which constitutes the innate aspect of an instinct, and which mediates between afferent and motor elements which are both capable of modification through learning (essentially conceived as conditioning), or imprinting. The emotion is a correlate of the action of the central element of an instinct - a conscious representation of its action in the organisation of behavioural response.<sup>2</sup> There is then a repertoire of innate action-organising dispositions which are associated with primitive kinds of stimuli, but whose perceptual triggers can be shaped through new association and learning, and whose motor output can be modified and refined. The system is goal oriented (escaping from danger or seeking the desired object) and organises typically effective behaviours in relation to classes of experience, which are each accompanied by a distinct emotion which prototypically persists until the goal is reached.<sup>3</sup>

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<sup>1</sup> McDougall 1910, p29.

<sup>2</sup> The use of the term instinct is equivocal in that in some respects it retains the sense of stereotyped response patterns evoked by specific stimuli that would be associated with the use of terms such as ‘instinctive behavior’ in ethology, but also suggests in the inherent flexibility of both afferent and motor elements, something other than the stereotypic.

<sup>3</sup> Tolman 1923; Cannon 1915, 1927; Marston 1928; Miller 1951. Rivera argues for the formal equivalence of these theories to that of McDougall [Rivera 1977].

Variations on this basic model, generally take the form of modifications to the relationship between the elements of affect and the instinct or drive. It is possible for instance to conceive that the primary drive system is independent of affect, except in so far as the affect system serves to amplify, modify or inhibit drives, whilst remaining independently responsive to a broader range of stimuli.<sup>4</sup> Variations of this kind, in rejecting a direct instrumental link between instincts and behaviour, draw in an important aspect of the emotions, by highlighting the fact that a large proportion of behaviours are learnt and that such learning is achieved by the direct association of appropriate behaviour with the positive and negative effect of the emotions. Whilst it is true that emotions are associated with behavioural goal-directedness, in the sense that fear leads us to run away, the emotion associated with this mechanism can acquire qualities in its own right. I can learn to like or loathe the experience of fear; to experience guilt in experiencing fear; and so on.<sup>5</sup> Similarly I can anticipate fear or anger, and learn to avoid the situations in which they are likely to arise. However, in acknowledging these aspects of emotional life, it becomes apparent that there is a theoretical shortfall in accounts which link emotion generally to behavioural accounts of instincts or drives

Whilst there must in principle be some innate basis for the constitution of the emotions, such as the capacity to experience pain, pleasure or desire,<sup>6</sup> it does not follow from this that all the emotions can be derived from these. On the other hand there is no in principle reason why all the emotions should not ultimately depend on these in some sense. If the primary emotions are the unmediated felt experience of body correlates, then the complex emotional world of secondary or derived affective states would appear to depend on their cognitive engagement. The association of experiences in the world with the neural correlates of action-organising dispositions (or their equivalents), which distinguishes the secondary emotions, requires the involvement of perception and cognition in their association. To feel pity, for example, requires the capacity to perceive and recognise the condition of another, and to associate appropriate feelings with that perception and recognition. To feel guilt, requires (inter alia) an understanding that one has done something which one recognises to have been wrong. In theoretical terms, the cognitive engagement of emotions has been approached both in the idea of 'value' and the idea of 'perspective', which are embedded in the above examples.

In the least socialised and least altruistic renderings of the idea of value, cognition is

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<sup>4</sup> For example Tomkins 1962. Although Tomkins account displaces the relationship between instinct and affect and thus opens up the possibility of broader contexts for emotional learning and development, he does not generally hold this view, positing independence of the emotions from culture and learning, particularly in the context of the nature and universality of facial expression. However, the nine primary affects that he postulates can be viewed as playing the role of substrate on which more complex emotional relationships can be built.

<sup>5</sup> This is in one sense the affective equivalent of connotation.

<sup>6</sup> Or some more primitive correlate such as 'pre-volitional striving' [Cavell 1993, p 149].



engaged in the particular sense of appraising or evaluating situations in terms of their implications for the person. At one level it involves an immediate and intuitive appreciation of value which initiates an action tendency expressed in various bodily changes that are felt as an emotion. This possibility of action is then subject to appraisal (of a non-intuitive kind).<sup>7</sup> Whilst the majority of such value oriented theories are expressed in behaviourist terms and implicitly, if not explicitly, related to forms of drive theory, it is possible to regard the nature of the evaluation as the product of an active organisation and constituting a symbolic system for representing the implications of a situated state of the person.<sup>8</sup>

From the perspective of 'perspective', emotions are seen as arising from some form of disjunction between what is the case and what we would like to be the case. The different conceptual positions developed in relation to this idea, generally reflecting the broader theoretical context in which they are embedded. The most familiar of these, takes the form of a psychoanalytic explanation in terms of the displacement of psychic energy. Emotions arise when there is conflict in instinctual demands, in relation to the unconscious instinctual energy released by a process in response to something perceived, and the energy fails to be discharged through normal (voluntary efferent) channels.<sup>9</sup> If the energy terminology is dropped, then the essence of the underlying idea is that emotion arises when we are unable to act, relative to our perceptions and intentions.<sup>10</sup>

In some respects this simple model concurs both with intuitions regarding emotion and with the commonly held view that their basis lies in an awareness of prevailing and changing bodily states. Anger, for example, arises when our actions are thwarted or our expectations are challenged, and the state of arousal associated with these are displaced. However it is also clear that this account does not universally square with the emotions as experienced. Guilt, for example, involves a reflection on actions performed or intentions previously held, which perhaps takes the form of a wish that these might somehow be annulled, and a feeling of pain associated with the reflection. In other words although there may be a group of primary emotions which form the foundation for the

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<sup>7</sup> Theories of this kind are reviewed by Arnold who holds a similar view. [Arnold 1960]. Given that the initial appraisal of a situation is intuitive, resulting in different classes of action tendency whose accompanying bodily changes when sensed constitute the emotion, the theory can be viewed as a variant on a drive theory, with the exception that the 'drive' expresses itself as a possibility which is consciously evaluated and does not directly lead to action. A similar view is held by Bowlby, who additionally contends that ones own states and impulses form part of what is appraised [Bowlby 1969].

<sup>8</sup> Within the general framework of psychoanalytic concepts, Angyal suggests that the affective states comprise a system for symbolising a situated evaluation of the general state of the self. The quality of an emotion is constituted by a location on a pleasantness-unpleasantness dimension, taken together with proprioceptive feedback from the body expressed in terms of excitement and tension. [Angyal 1941].

<sup>9</sup> For example, Rapaport 1942.

<sup>10</sup> For example Dembo 1931 [also discussed in Sartre 1939].

complexity of affective states, the bulk of which can only be understood in cognitive terms and not simply through reactive psychophysical models.

A cognitively rooted, but otherwise similar theory is represented in Sartre's conception that although emotions are directed towards an object, this is not simply an object out there in the world, but rather an object of consciousness - a purpose framed by the mind or something meant or signified by it.<sup>11</sup> An emotion is then a 'specific manner of apprehending the world'.<sup>12</sup> We see the world from a certain perspective, and in particular in terms of the demands that it makes and the opportunities that it offers.<sup>13</sup> In relation to our goals this enables us to build an instrumental map of the world, and concomitantly to view the world through the map, as being of our own making. In reality of course, that world throws up perceived obstacles that we then seek to overcome. In the normal course of events we treat the world as logically determinate and take action accordingly. When the obstacles become too great, and the world appears not to conform to this strategy, we shift to a different perspective in which we change the rules of the game, and substitute a change in ourselves for the instrumental change that we cannot conceive or accomplish. This change in perspective is essentially an emotional change - a change in the state of our relation to the world, which is now conceived on a non-determinate and 'magical' model. When a face appears unexpectedly at the window, the feeling of fear or terror results from our inability to continue to view the world in terms of instrumental possibilities, but only as 'one non-utilisable whole'.<sup>14</sup> The perspective and distance afforded by instrumentality is abolished, as we shift to a different relation to the world, in which there is no longer any strict separation between self and other, and reality and fantasy. As Sartre expresses the idea :-

'To put it simply, since the seizure of one object is impossible, or sets up an unbearable tension, the consciousness tries to seize it otherwise; that is, tries to transform itself in order to transform the object.'<sup>15</sup>

Although Sartre would presumably not wish to make the connection, given his critique of Freud, there are clear parallels between this account and some aspects of psychoanalytic theory. The latter in some of its versions would for example regard this engendered change in perspective in terms of reversion to more infantile states. For instance, in the

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<sup>11</sup> Sartre bases his account on a rejection of the idea of the unconscious, and specifically in terms of a critique of the Freudian account, in the light of an acceptance of a phenomenological reading of the implications of Descartes' Cogito. The background to this is discussed, for example by Warnock in her introduction to Sartre's theory [Sartre 1939, 1962 pp 4-9]; the related phenomenological tradition by Chisholm [1961]; and the relation of these to existentialism by Merleau-Ponty in his introduction [Merleau-Ponty 1945].

<sup>12</sup> Sartre 1939 [1962, Eng Trans p 57].

<sup>13</sup> An existential version of the idea of 'affordance', and therefore grounded in the possibility of choice rather than in terms of a natural disposition

<sup>14</sup> Sartre 1939 [1962, pp 88-90, quoted phrase p 90].

<sup>15</sup> Sartre 1939 [1962, p 63].

projection of intentionality or animation to the inanimate,<sup>16</sup> or more radically in the case where distinction between self and world is inoperative, and instrumentality is subsumed in omnipotence.<sup>17 18</sup>

Although in these accounts, emotion is generally represented as a response to special sets of circumstances in which rational or instrumentally perceived action is rendered inoperative, it is possible to take the view that these alternative perspectives normally occur in parallel. Indeed the theory and evidence provided by Damasio,<sup>19</sup> for example, supports the view that a non-instrumental perspective is always present in body monitoring and coexists and co-participates in cognitive processes generally, and are foundational for them. Nevertheless in respect of our encounters with objects, the emotional content of our relationship with them, can be seen to reflect aspects of both these views. Within the general framework of gestalt psychology, for example, Koffka has argued that emotional qualities are perceived in relation to objects when :-

'... objects are in dynamic relations with the ego, when, otherwise expressed, a state of tension exists between them and the ego. It is important to keep in mind that the kind of tension will vary for the different physiognomic characters. Not only will it be different in sign - positive or negative - and in degree, but also in quality. The kind of tension will determine our responses : attack, flight, approach, success, disregard, compassion, and so forth.'<sup>20</sup>

Arnheim has also noted the personal qualities associated with the physiognomic perception of objects, which are comprehended in emotional terms.<sup>21</sup> Our ability to recognise emotional expression resulting from the common structure which underlies both the experience of an emotion and the organisation of expressive behaviour.<sup>22</sup> This has its parallel in the emotional component of perception, in the form of an attribute described as a 'directed tension', which accompanies all percepts and underlies expression generally, and emotional expression in particular.<sup>23</sup> The commonality of the underlying structures allowing for the development of perceptual cross-domain isomorphism, and thus accounting for the perception of emotions or moods in both natural and artificial objects and environments, in addition to persons. Our qualitative discourse about products is run through with the joint terminology of the physiognomic and the emotional - from the 'sad

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<sup>16</sup> Graves 1988.

<sup>17</sup> Although the parallel is clear, the psychoanalytic account would ultimately be driven by the respective roles and relationship of conscious to unconscious processes - a dichotomy which Sartre would reject.

<sup>18</sup> Dembo 1976.

<sup>19</sup> See below, pp 441-446.

<sup>20</sup> Koffka 1935, p 362

<sup>21</sup> Arnheim 1958.

<sup>22</sup> Arnheim 1949.

<sup>23</sup> Literally 'directed' in the sense of directional movement and its associated properties and qualities - direction, speed, rhythm, phrasing, amplitude etc [Arnheim 1958].

looking teapot with its drooping spout', via the 'humble' chair, to the 'authoritative' desk and the 'majestic' suspension bridge.

### *Psychology, Neurology and Ethology*

The thrust of the theoretical perspectives to this point, have been presented in the terms of philosophical psychology. The empirical evidence drawn from neurological, psychological and ethological studies will be reviewed, and their implications for particular standpoints in philosophical psychology, assessed. Consideration of the diverse range of material encompassed by such studies, will be organised in terms of the three characterising features of emotion defined above - a) environmental or object orientation, b) associated behaviour, and c) subjective experience.

#### *a) Environmental Orientation*

Taken broadly, environmental orientation refers primarily to the capacity for adaptive response to external conditions and objects, and is chiefly represented in physiological and neurophysiological theories. As such it captures both the phylogenetic adaptation to broad environmental parameters represented for example in evolved homeostatic systems, and also to ontogenetic developmental adaptivity in the realm of cognition, and particularly in socialised contexts of coordination and communication. Phylogenetic adaptation will be considered first. (The cognitive aspects of object orientation and adaptation will be considered in retrospect following discussion of associated behaviour and subjective feelings).

The type of phylogenetic adaptation that has most bearing on the nature of emotion, consists primarily of the homeostatic mechanisms represented in the autonomic nervous system and the endocrine system which control basic system functions such as respiration, circulation, digestion, temperature regulation; automatic fight or flight responses; and the systems of inter-individual chemical co-ordination and communication captured by the term exocrinology. The autonomic nervous system, controlled primarily by the hypothalamus, consists of two branches - the parasympathetic, which primarily supports the anabolic aspects of homeostasis, and the sympathetic, which is catabolic and supports flight or fight reactions. The two branches are essentially antagonistic and are generally co-present in the structures to which they are connected. The physiological theory of emotion proposed by Cannon, is based on the action of this antagonistic pair of systems, and in particular the physiological changes that occur when the sympathetic system becomes dominant.<sup>24</sup> The counterbalancing action of the parasympathetic system

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<sup>24</sup>Cannon 1939.

has been described by Sternbach.<sup>25</sup> It is generally recognised that optimal behavioural efficiency can subside in the face of overarousal of the sympathetic system leading to stress and apathy.<sup>26</sup> The endocrine system serves similar homeostatic and adaptive functions, through the release of hormones, operating at a slower pace and over longer time scales,<sup>27</sup> and also leading to stress through overactivation.<sup>28</sup>

The theoretical thrust of physiologically oriented theories, following their independent proposal by James and by Lange, is that emotion either consists in the activation of certain physiological states, or that such physiological states are at least necessary for emotion, and that there is an evolutionary basis for the existence of such states. In their simplest form physiological theories equate emotion with visceral response, following James. This basic account is elaborated with varying degrees of complexity, primarily in terms of the nature and extent of the associations that are formed with the various elements of this underlying mechanism.<sup>29</sup> In addition a number of theories stress the centrality of the concept of arousal, typically linking emotion with motivation.<sup>30</sup> Whilst others emphasise the distinction between the behavioural and experiential aspects of emotion.<sup>31</sup>

The more general sense of object orientation in theoretical terms is articulated in cognitive terms and discussed below in the context of cognitive theories and subjective experience.

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<sup>25</sup> Sternbach 1966.

<sup>26</sup> Hebb 1955; Arnold 1960.

<sup>27</sup> Buck 1976, chapter 2.

<sup>28</sup> Selye 1978

<sup>29</sup> Wenger [1950] for example, accepts the basic hypothesis, but views emotional states as complexes based on visceral response derived from the activation of the autonomic nervous system, emotional stimuli being dependent upon the pairing of conditioned and unconditioned stimuli. Cannon [1932] although starting from a behavioural standpoint, emphasises the neurophysiology of emotion, arguing for a structural similarity between emotions in which the thalamus is activated by the cortex in parallel with the processing of information from receptors, the quality of emotion consisting in the addition of thalamic arousal to basic sensation. Damasio [1994], at the other extreme, accepts the somatic basis of emotion in the context of a sophisticated neurophysiological framework, but emphasises the importance of interaction with cognitive functions in the development and refinement of all but the most basic of emotional responses.

<sup>30</sup> Lindsley [1957] provides a neurophysiological account of arousal in terms of interactions between the reticular formations and the limbic system which control motivational behaviour and emotional behaviour and expression. The concept of emotion is strongly linked to other phenomena such as attention and vigilance. Bindra [1969] accounts for both emotion and motivation in terms of a single construct - 'central motive state' which generally subsumes species typical and biologically useful actions. Such states are engendered by a combination of 'incentives' (external stimuli) and physiological change represented in the central nervous system. The central motive state contributes to behaviour by biasing sensory input or motor response.

<sup>31</sup> MacLean [1993] bases a neurophysiological account on a range of earlier work asserting that the experiential aspects of emotion require processing by the cortex, whilst behavioural expression of emotion need not. MacLean argues on structural grounds that the limbic system integrates emotional experience, whilst behavioural response is controlled by the hypothalamus.

### *b) Associated Behaviour*

Unsurprisingly, the chief characteristic of theories of emotion that focus on the externally observable behaviour associated with emotion, is that they are typically, though not exclusively, 'behaviourist' in a philosophical and methodological sense. Watson, for example, proposes three basic types of emotional reaction, roughly equivalent to fear, anger and love, which are exhibited in children in response to distinctive kinds of stimuli.<sup>32</sup> In physiological terms emotions are conceived as equivalent to hereditary 'pattern-reactions' involving wholesale change in body mechanisms and particularly of the visceral and glandular systems.<sup>33</sup> The principal developments of Watson's behaviourist approach take the form of a variety of models linking the refinement and extension of emotion concepts to conditioning, in one form or another.<sup>34</sup> The logical possibilities of a scheme based on the three basic types of emotional reaction, analysed in terms of the application or removal of negative and positive conditioned and unconditioned stimuli, have been explored by Millensen and presented in the form of a three dimensional co-ordinate system.<sup>35</sup> Although the co-ordinate system only includes the 'primary' emotions, other emotions are accounted for by pairings of stimuli with more than one primary emotion. Thus guilt, for example, consists in something being a conditioned stimulus for a positive unconditioned stimulus and also for a different negative unconditioned stimulus.<sup>36</sup>

In giving some consideration to physiological and behavioural theories of emotion, a number of common tendencies emerge which raise general questions regarding theoretical issues. Firstly, it is notable that very few theories of either type restrict themselves to the methodological constraints that are implied by their orientation, and that most theories either explicitly or implicitly point to cognitive factors as being significant in any account

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<sup>32</sup> Watson posits three basic behaviour types. The 'X' type, which involves puckering of the lips, crying, closing the eyes, hand clutching and catching of the breath, is evinced by sudden positive or negative stimuli. 'Y' type behaviour involves crying, screaming, holding the breath, body rigidity and limb thrashing, and is stimulated by constraining the body or preventing movement. 'Z' type behaviour is characterised by smiling, cooing and gurgling in response to gentle body contact such as stroking or cuddling [Watson 1929].

<sup>33</sup> Watson 1929, p225.

<sup>34</sup> Amsel [1962] for example, develops a model based on the frustration that occurs in situations in which expected rewards are not fulfilled, leading to conditioning of anticipatory frustration and related changes in drive strength. Weiskrantz [1968] defines emotion as a complex response state, and part of a cycle of response and reinforcement, within a Skinnerian framework. This is echoed in the work of Staats and Eifert [1990] who similarly regard the stimuli that act as emotion elicitors in classical conditioning as the same stimuli that act as reinforcers in instrumental conditioning. Hammond [1970] characterises emotion as a central state which is triggered by unlearned stimuli in the form of rewards or punishments. Learned stimuli become associated with unlearned stimuli, through classical conditioning, and acquire their characteristics. Emotion is treated within a motivational framework and in terms of drive induction and reduction, which are equated with pain and pleasure.

<sup>35</sup> Millensen 1967.

<sup>36</sup> For example, in stealing something (o), o is a conditioned stimulus for the positive stimulus of having it, and a conditioned stimulus for the negative stimulus of being punished for having it.

that seeks to deal with all emotions, and in distinguishing emotional responses from other forms of response. Secondly, although in general, theories of both types recognise the relevance of socio-cultural contexts of emotion, this aspect has been virtually neglected, empirically and theoretically. The interpersonal aspects of emotion have been generally ignored in behavioural theories, and the physiology of interaction ignored in physiological theories. Thirdly, most theories have focused on a restricted range of affective states, particularly the more primitive emotions, in the context of which, accounts have been developed which are then extended to other affects on the assumption that they are variants which can be subsumed by the same or similar analysis.

### *c) Subjective or Intrapersonal Aspects*

Although any simple basis for the classification of theoretical approaches in a complex interdisciplinary field such as the study of emotion, will inevitably founder, it is true to say that subjective and intrapersonal factors play only a supporting role in physiological and behavioural theories.<sup>37</sup> The principal approaches in which such factors are brought to the fore are represented generally in cognitive theories and phenomenological theories.

#### *Cognitive Theories*

One predominant facet of a cognitive approach to emotion lies in the central place given to the concepts of appraisal or evaluation. This typically takes the form of a view that appraisal is a complement to perception, giving rise to a tendency to action with an accompanying affective experience.<sup>38</sup> The nature of appraisal and the possible dimensions of appraisal and their relation to distinct emotions have been explored by a number of writers, some regarding them as underpinned by virtually automatic response mechanisms and others as essentially expressed in terms of cognitive complexes.<sup>39</sup> In either case the full development of the emotions is associated with cognitive elaboration in some form. To some extent, the distinction between theories can be articulated in terms of the phasing of appraisal and affect in the sequence from stimulus to behaviour. The common sense view, for example, generally sees a stimulus as being appraised or interpreted, giving rise to an emotion which in turn generates a particular behaviour.<sup>40</sup> Theories which give priority to motor feedback or physiological processes on the other hand, link the stimulus and the behaviour, giving rise to the affective element, which is then subject to

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<sup>37</sup> Nevertheless in many such theories cognitive elements are both acknowledged and necessary.

<sup>38</sup> The concept of appraisal in this form was championed particularly by Arnold [1960], who with the exception of the most basic experiences such as pleasure or pain, links appraisal to memory and to 'imagination' in the sense of forward projection. See also Lazarus 1984.

<sup>39</sup> Smith and Ellsworth 1985; Ellsworth 1991; Frijda 1993.

<sup>40</sup> I see my wife walking down the street with another man, interpret this as infidelity, feel an overwhelming anger which drives me to violence.

interpretation. Theories which emphasise affective primacy view the affect as being engendered in response to a stimulus, and then interpreted, so leading to behaviour. Appraisal theorists, on the other hand, generally regard the idea of a simple sequence of any kind as inadequate to capture the cyclical and interactive nature of affective states with the other elements involved in perception, cognition and action.<sup>41</sup>

Although these caricatures inevitably obscure the complexity of individual theories, they do point to distinct elements which parallel underlying ideas in philosophical psychology, including the idea of affect as a cause of behaviour, as an epiphenomenon of behaviour, as an epiphenomenon of the cognition leading to behaviour, or as an effect accompanying perception which participates in cognitive processes. The likelihood is that these elements are all true of affective states in some measure, the theoretical emphasis deriving from the particular emotion or system level which is the focus for empirical work.

Nevertheless a centrally contentious issue in cognitive approaches, has continued to be the degree to which affective and cognitive processing are perceived to be separate and distinct, or, if essentially co-embedded, which of them has primacy. One point of view championed by Zajonc, is that emotion and cognition are essentially distinct systems and that emotion precedes cognition.<sup>42</sup> Lazarus, as the principal exponent of the alternative view, argues that cognitive appraisal of meaning underlies all emotional states.<sup>43</sup> Although this polarisation is still evident in cognitive accounts of emotion, the predominant view that has emerged is of a complex developmental picture in which both cognition and emotion participate, although there are acknowledged to be simple underlying emotional reactions which lack cognitive content. It has also been argued that a precise all-through definition of emotion and cognition is neither possible nor helpful, but rather that emotions participate in a hierarchically arranged system of processing working at sensory-motor, schematic and conceptual levels, the lowest level of which permits of a distinction, whilst the upper levels allow only for relative distinctions within a complex of interactions involving both cognition and emotion.<sup>44</sup>

An alternative approach which is evident in a number of theories centres on the assumption that emotions, if not encompassed by cognition, nonetheless serve important cognitive functions. Bower, for example, proposes a network theory which is essentially a descriptive model of the interaction of mood with cognition (represented in the exposition primarily by memory). Emotions are conceived as central nodes in a semantic network which are richly connected with ideas, events, expressive patterns, and bodily

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<sup>41</sup> Ellsworth 1991, pp156-157.

<sup>42</sup> Zajonc 1984.

<sup>43</sup> Lazarus 1984

<sup>44</sup> Leventhal and Scherer 1987.



activity in the form of muscular patterns and autonomic activity. Emotion related matters are propositionally encoded in a subject-object-response format. The network operates through the selective interanimation of nodes, which may originate from nodes of various types, and weighted both in terms of intrinsic weighting relations and as a result of learning.<sup>45</sup> The upshot of the model is the implication that there is a fundamental congruity between cognitions and moods, and that affective states such as moods act as a reference system and a coherence engendering mechanism for other cognitive functions such as memory. Recall, for example, is conceived as state dependent and functioning optimally where there is an affective match both in type and intensity between learning and recall, and similarly that learning is more effective where there is an affective match between the state of the person and the emotional tone of the learning material.<sup>46</sup>

A similarly based view is espoused in the theory proposed by Oatley and Johnson-Laird, in which emotion 'modes' act as a priority-switching factor in relation to multiple goals.<sup>47</sup> In common with the general thrust of Johnson-Laird's work in relation to the cognitive structure of perception and linguistic reasoning, the emphasis is on the idea of goals as symbolic representations of desired external change, and plans as sequences of representations linking goals and the external world.<sup>48</sup> Emotions function in this realm in the co-ordination of both individual and collective plans, and are socially conceived. The primary way in which they do this is in relation to the characteristic evaluative junctures in plans. Emotions arise when plans are interrupted and allow a transition between different possibilities of planned behaviour, particularly in relation to complex and unpredictable environments, which are essentially socialised.

A further slant on the interaction between cognition and emotion, in terms of the distinction drawn between appraisal and knowledge as two forms of cognition is evident in the work of Lazarus and Smith.<sup>49</sup> Whilst knowledge is conceived as cognitions of matters of fact and their causal or instrumental relations, appraisal is essentially a form of personal meaning consisting of evaluations of these cognitions in terms of their significance in relation to goals and beliefs. Primary appraisal consists in determining the extent to which events are significant in respect of personal goals, and the extent to which

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<sup>45</sup> Bower 1981; Gilligan and Bower 1984.

<sup>46</sup> Singer and Salovey [1988] have argued that although there is considerable empirical support for the congruity thesis, this is generally stronger for positive rather than negative affect. In addition the role of affect may be more restricted than the theory suggests, emotion functioning primarily as a contextual cue and generally only cognitively significant in the case of competing contextual cues.

<sup>47</sup> Oatley and Johnson-Laird 1987.

<sup>48</sup> Johnson-Laird 1983.

<sup>49</sup> Lazarus and Smith 1988.

they are congruent with a framework of desires and beliefs.<sup>50</sup> Primary appraisals and their secondary constructs are not sufficient to determine personal meaning or affective significance, but are informed by further cognitive constructs termed 'core relational themes' which capture types of transactional relationship with the environment - for example the themes of gain and loss, which are held respectively by happiness and sadness. This last construct, which bears a close conceptual relation to the idea of a schema, provides the key link between cognitive theories and the phenomenological theories which will be considered below.

### *Phenomenological Theories*

Whilst cognitive theories seek to account for emotional experience in terms of the components of mental and physical functioning, and ultimately to ground the notion of self and consciousness in similar terms, the phenomenological approach is based on the contention that experience is not reducible to sense contents, components or structural elements, and that the sense of self is primary. Phenomenological theorists therefore focus on the experience of the present as experienced, and in respect of emotion, in terms of the particular qualities and distinguishing features of emotional experiences themselves.<sup>51</sup> In terms of their general contribution to the development of theories of emotion, they have provided an essential link between the cognitive concept of 'schemas', the commonsense account of emotion and the taxonomy of affective states.

Although accounts of emotion in phenomenological psychology have a long history, which includes a variety of shades of psychoanalytic theory,<sup>52</sup> in addition to the phenomenological tradition proper,<sup>53</sup> the more influential theories have been structural in tone. Of these the work of de Rivera represents in its earlier forms the most taxonomic and semantically oriented output,<sup>54</sup> and latterly a highly socially-centred phenomenological orientation.<sup>55</sup>

The structural theory is based on the idea that our emotional experience reflects the transformation of our relation to the world. Different emotions involve different kinds of transformations which are conceived as transactions with the world, modes of organising

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<sup>50</sup> There is a parallel here between the appraisal/knowledge distinction and the belief/acceptance distinction in practical reasoning, see pp 348-350 above, and Appendix E.

<sup>51</sup> Some of the character of this approach is indicated in the discussion of Sartre, above pp 431-432.

<sup>52</sup> Rapaport 1942; Hillman 1960.

<sup>53</sup> Husserl 1913; Sartre 1939; Merleau-Ponty 1963; Buytedjik 1950.

<sup>54</sup> Rivera 1977.

<sup>55</sup> Rivera 1992.

our relations with the world in order to create meaning.<sup>56</sup> Individual emotions form part of a network of emotions and affective states, and are related as a network to other forms of relation, constituting a system which governs object relations.<sup>57</sup> The phenomenological underpinning is expressed in terms of the 'movements' of the emotions, the sense of the directedness of feelings - anger is directed towards an object, and moreover intends the moving of the object away from the self.<sup>58</sup> Fear on the other hand intends the moving of the self away from the object. On the basis of a systematic examination of the subtleties of movement conceptions and their particular form as the content of individual emotional experiences, deRivera establishes a phenomenological taxonomy of fundamental emotion terms such as love, desire, anger and fear, in terms of positive and negative movement relations in transactions with 'the other'. These are developed to include further physically expressed feelings, such as holding and letting go, in the definition of subtler and more abstract emotions such as security, confidence, depression and anxiety. Movements are conceived as occurring in a three-dimensional psychological space, whose dimensions are 'belonging', 'recognition' and 'being', yielding a matrix of twenty-four basic emotions. The matrix is used to classify 154 commonly used emotion terms, and tested by asking subjects to classify the term in respect of positive and negative movement and to allocate it to the dimensions of the space.

The functional aspect of the structural theory places emotion firmly in the social realm, as a system which mediates transactions between the self and the other.<sup>59</sup> More recent work by the same author has further emphasised the social context of emotion, focussing on the concept of an emotional atmosphere (a collective but essentially local response to a particular event), emotional climate (a more stable and enduring collective response which is nonetheless responsive to social factors) and emotional culture (an enduring and relatively stable collective state represented in the social structure and institutions of a given society).<sup>60</sup>

The links between phenomenological theories and cognitive or behavioural theories are represented in the common approaches that they employ in the investigation of the experience of affective states. In general the strategy has included the structural analysis

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<sup>56</sup> Transactions occur which involve the environment, objects, events, actions etc, with particular importance given to relations with other people, which provides a model for transactions in general. The term 'object relation', which is primarily used in psychoanalytic theory to describe relations with other people is here used to describe relations of all kinds.

<sup>57</sup> The conception is clearly closely related to some expressions of cognitive theory, for example Bower 1981

<sup>58</sup> Either to drive away, for example, or to destroy (to re-move).

<sup>59</sup> A similar theory is proposed by Denzin [1984] in terms of a socially centred self, defined by reference to anything that can be called 'mine' at a given time, and the meaning that this sense has for me. Emotional experience has a dual function, referring to the self but also in terms of the other. Typically, associated judgements are made in the form of justifications, and involve both self-appraisal and appraisals of by others.

<sup>60</sup> Rivera 1992.

of protocols and the use of semantic analysis in relation to affective terms or descriptors. The structural theory of de Rivera discussed above, for example, is based on the cumulative comparative analysis of the distinctions in content of successive affective terms, expressed ultimately as a three-dimensional affective semantic space. This approach has had a long history in the study of emotion, since the introspectionist model developed by Wundt, based on the identification of dimensions of affective experience such as pleasure-displeasure, strain-relaxation, excitement-calm, within which all emotions could be encompassed.<sup>61</sup> A variety of attempts have since been made to establish quantitative techniques for affective mapping, including in particular the classification of facial expression.<sup>62</sup> The thrust of such studies have identified some combination of two or more dimensions, generally including - an evaluative dimension (pleasantness-unpleasantness), an arousal dimension (relaxation-tension) and a focal attitude dimension (attention-rejection). The principal methodology used, however, has been the analysis of the meanings of terms using the semantic differential.<sup>63</sup>

### *Affective Representation - Somatic Marker Hypothesis*

A number of theories make implicit or explicit recognition of the above in their general orientation and development, tending to be rooted physiologically, but encompassing some behavioural, cognitive, phenomenological and systematic elements. A recent and developed example is the theory proposed by Damasio, which is rooted in clinical and experimental neurophysiology, but with an essentially cognitive orientation and explanatory structure. An account of this will serve as an indication of the general way in which cognitive and behavioural models can be neurally and physiologically grounded.

Damasio sustains a case for the dependancy of the development of intellectual powers upon emotional development, which are in turn founded on neurophysiological organisation relative to body monitoring and the general capacity to react and respond in the environment. He emphasises the importance of the continuing links between emotion and reason in the overall cognitive strategies adopted by individuals, particularly in relation to their development in social contexts.<sup>64</sup>

Recent work in neurobiology and neurophysiology has elucidated a number of the key mechanisms involved in emotional response and emotional learning. It has been shown

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<sup>61</sup> Outlined in Parkinson et al 1996, pp 19-20.

<sup>62</sup> Schlosberg 1952; Abelson and Sermat 1962; Dittman 1972; Izard 1972; Russell and Bullock 1985.

<sup>63</sup> Osgood et al 1967.

<sup>64</sup> This includes both ontogenetic and phylogenetic social contexts. Support for the latter is drawn from cognitive evolutionary studies which point, for example, to the correlation between brain size and structure and increase in size and complexity of social groups. [See for example Donald 1991].

that the formation of memories, recall and learning of primitive emotional experiences such as fear, involve at least two distinct neural routes one of which is cortical and the other sub-cortical.<sup>65</sup> The sub-cortical route, which is the more primitive, involves signals passing directly from the thalamus to the lateral nucleus of the amygdala. Signals also pass from the thalamus to the cortex and thence to the amygdala via the hippocampus. The short route enables the brain to store primitive cues and detect them rapidly, without detailed analysis, and to initiate defensive fear responses. The longer route via the cortex enables the sensory information to be analysed in detail and integrated with more extensive knowledge, which can verify or refute the cues and modify the reaction.

Taken in isolation findings such as these appear to support a general and long standing thesis concerning the division of labour in the brain, in which the more primitive brain structures such as the hypothalamus are conceived as being responsible for the processing involved in biological regulation and response selection, whilst newer structures such as the neocortex deal with reasoning and other higher order cognitive functions. The parallel development of size and complexity in the brain has been correlated with increasing complexity in the environment and related both to the ecological need for greater perceptual discrimination and associated memory and increase in size and sophistication of social groups.<sup>66</sup> This division of labour is also typically equated with the distinction between emotion and reason.

If experimental results such as those noted above are taken together with an emerging picture of a far more complex and distributed network than that implied by structural division reflected in simple functional correspondence, then a very different model of the relation between emotion and reason emerges. This model is based on the somatically centred concept of the emotions, independently proposed by James and Lange towards the end of the nineteenth century.

Although William James was the first modern psychologist to suggest that the basis of emotion and feeling was attributable to bodily states and symptoms, his conception was restricted in the sense that he regarded it as an automatic reaction unmediated by evaluative processing. Although there are unmediated responses of this kind, there is little doubt that the majority of our emotional responses only occur after mental processing associated with evaluation. Nevertheless it seems likely that the complex structure of emotional response involving evaluation is ultimately based on the use of the pre-organised structures in the more primitive parts of the brain which had evolved to provide rapid and automatic responses. The substance of these automatic responses consist in a triggering of

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<sup>65</sup> Le Doux 1989, 1992, 1994, 1996.

\* Damasio 1994; Donald 1991.

the limbic system, following detection of selected combinations of perceptual features, yielding a preset body response held as a dispositional representation. The collective body response defines the emotion, but there is an additional feature - our experience of feeling the emotion, which consists in making the connection between the experienced body response and its object. The evolutionary advantage of this development is that it enables greater flexibility of response to the environment. This is constituted in a number of ways by associating a greater range of cognitive information with the stimulus and its contexts and so gaining greater predictive power and strategic advantage.

The innate mechanisms supporting urgent global bodily response constitute the 'primary' emotions, upon which the full range of secondary emotions are built. These arise from the systematic development of cognitive connections between the categories of objects and situations of our experience, and the primary emotions. The full range of changes that occur in the various body systems constituting a total bodily response in the case of a primary emotion can be harnessed in the acquired dispositional representations that become associated with them through individual experience. These bodily changes are in turn signalled to a number of different areas of the brain, providing on-line monitoring. The process of continuous monitoring coupled with the content of other cognitive processes constitutes feeling. Feeling an emotion is a special case of feeling, in the sense that it is the experience of such monitoring of emotional body change juxtaposed with the mental images or representations that initiated the emotion.

The subtle variety of feelings that can be experienced, are based on variations to the most universal emotional schemata which correspond to body response profiles that are innate or pre-organised - fear, anger, happiness, sadness, disgust. These are experienced as feelings when the body conforms to their respective emotional profiles, and attention to the related signals from monitoring increases. The subtler feelings based on these arise from more complex cognitive content coupled with variations to the body-state profile and are clearly experientially and culturally relative. In addition to feelings directly or indirectly associated with emotions, there is also a continuous monitoring of body state when it is not subject to the perturbing effect of emotion. A sustained background state with a particular bias in overall character is equivalent to 'mood'.<sup>67</sup>

This picture of the constitution of the emotions developed by Damasio is essentially cognitive, and the feelings associated with them are on a par cognitively with other perceptual images. The distinction lying in the content of the cognition, which in this case comprises images of our changing bodily state as it responds to the triggers of pre-organised mechanisms and the cognitive structures that have become associated with

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<sup>67</sup> Howarth 1995.

them. The relationship between reason and emotion is based on the role of these cognitive structures in thinking generally, and expressed systematically in Damasio's Somatic Marker hypothesis.<sup>68</sup>

In reasoning involving choices, particularly in the domain of practical reason, classical models based on equating the structure of thinking with the laws of logic (or logics) have been unable to account for either the capacity for complex judgement or the strategies that can be inferred from the evidence of thinking styles. It has been argued that in order to make sense of judgemental capacity, mechanisms must operate to effectively partition or restrict the field of alternatives, and the somatic marker hypothesis represents one account of how this is achieved. Essentially the idea is that the cognitive structures representing categories or schemata of objects and situations linked to feelings are redeployed in the concrete representations of scenarios that accompany reasoning about choice. Such reasoning often takes the form of means-end reasoning and it is clear that a major feature of the representational complex associated with such reasoning consists in envisioning outcomes and intermediate states. The somatic marker hypothesis proposes that the representations of envisioned outcomes or developmental scenarios are associated with categorially similar situations that are tagged or marked with associated emotional states and feelings, and attract the tone of such states or feelings, which are then experienced in terms of 'as if' bodily experiences. These experiences carry with them the positive or negative connotations, and other subtler shades, which are transferred to the envisioned scenarios, constraining or colouring the role that they are then allowed in the context of selecting a course of action.

Clearly this is not the only search space reduction strategy that is available, neither is it clear that it constitutes the primary strategy in all reasoning contexts, although it appears to be a particularly important factor in practical reasoning in social contexts. In this respect the findings relating to the links between emotion and reason from neurology and cognitive neurophysiology can be seen to concur with some aspects of the nature of practical reasoning established in the context of cognitive psychology. In particular, the deontic strategy employed in practical reason which can be characterised as 'detection of rule breaking' and which reflects enhanced sensitivity to rule violation perceived as a negative social outcome.<sup>69</sup>

The somatic marker concept proposed by Damasio can be extended to encompass a further and more familiar form of body monitoring - kinesthetic feedback, which in addition to serving automatic functions relating local body position and movement to

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<sup>68</sup> Damasio 1994

<sup>69</sup> See above 'deontic reasoning' pp 348-350.

overall postural balance, for example, provides an accessible on-line facility which can be engaged cognitively in intentional action. In so doing, it is subject to a similar dual feedback circuitry in respect of neural and chemical pathways and a distributed network, as the mechanisms encompassing emotional response and monitoring. There are then at least two distinct body maps held and updated, one which is essentially a map of relative spatial location of parts, and the other a map of relative levels of arousal or activity. They are interactive at least in the sense that the sensed activity associated with emotion can generally be localised. It can be argued that since these systems are both in full play in the context of social interaction and decision-making, then it is likely that either their co-existence provides the underpinning that makes social interaction possible, or increase in demands from social interaction has selected for their development both independently and interactively, or that both processes have been involved in their joint development.

The basis for the assumption of body mapping hypotheses is essentially that they meet two sets of criteria. The first is that they provide a systematic account of cognitive structures and mechanisms which is compatible with the available empirical evidence, and which though in principle falsifiable is not in fact falsified by that evidence.<sup>70</sup> The second is that their structure and development are compatible with an evolutionary account in terms of successive stages in their acquired survival value. The essence of the argument in this context, which differs from the detail of Donald's conception of evolutionary cognitive development, though compatible with its broad thrust,<sup>71</sup> is as follows. The survival value of the addition of mental responses to motor responses in evolutionary development comprised three main advantages that could be gained by the organism. Firstly a greater specificity in characterising the external environment through experiential modification of the conditions controlling aspects of receptor-effector relations; secondly through the refinement of motor responses themselves; thirdly through the introduction of anticipatory or predictive feedback loops. It is argued that this general pattern of development as conferring survival value, operates at the lowest levels of responsive organisms, and is perhaps the primary means for such development.<sup>72</sup> At higher levels it is argued that survival implies survival of the whole organism and it would therefore be necessary for representations to encompass the body generally in relation to both internal

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<sup>70</sup> Clearly it is not the only account which could be compatible with the evidence, neither is compatibility in itself a guarantee that it is a correct account. It could for instance be the cognitive equivalent of Kepler's epicycles, which will have to wait for the Tycho Brahe of cognitive science before a more elegant account can be provided, and for a Newton to locate it definitively and axiomatically.

<sup>71</sup> Donald's account [Donald 1991] is essentially a schematic functional account which posits the development of specifically identified capacities, which are associated in a general way with brain development. It does not provide a picture which allows for the degree of distribution which is currently associated with the models of the implementation of such capacities generated within cognitive science and neurology.

<sup>72</sup> Sayre, for example, has argued that the development of consciousness consists in the development of ever greater levels of sophistication in the nature of feedback. At the lower levels this is represented in the transition from simple negative feedback, via heterotelic feedback to anticipatory feedback [ Sayre 1976].



and external actions, to regulate and protect the organism. At the highest levels the intermapping of different representations, in co-ordination with the phasing of a variety of cognitive processes, together with the possibility of mapping maps (termed representational redescription in some accounts)<sup>73</sup> supports the sophisticated development of conscious awareness and response, and for Damasio at least, the essence of the sense of self and consciousness.

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<sup>73</sup> Clark and Karmiloff-Smith 1994.

## Appendix C Mapping Affordance and Meaning

It is proposed that the nature of affordance, perceive-affordance, representation, communication and meaning, and their conceptual relations can be explored by mapping them to a simplified interactive system model. The basis for this is that product semantic accounts deploy these central concepts as higher level (abstract) constructs which are taken to capture and generalise the key features of both object relations (environmental relations) and interpersonal relations. The presumption is that although these are cognitively implemented in a complex form, it is possible to establish meaningfully the nature of such relations in abstraction from the detail of the mechanisms which constitute their actual implementation. The strategy of this section will be to accept this assumption and to develop and apply a simple interactive system model which can be used to examine the nature of, and relations between, the key product semantic concepts.<sup>1</sup> The implications for cognitive systems, particularly where the nature of these are filled out in product semantic accounts, will then be addressed in retrospect.

A suitable model will need to have certain definable characteristics. In the first place it will need to be able to express interactions between systems and objects (environments), and interactions between pairs of systems, at an appropriate level of abstraction. The level of abstraction is defined primarily by the terms in which the concepts are articulated in product semantic theory, which is to say that systems are presumed to have goals, a capacity for effective behaviours, and a potential sensory capability.<sup>2</sup> Similarly objects or environments are presumed to have aspects which provide the basis for physical interaction (the deployment of effective behaviours), and for sensory engagement.<sup>3</sup>

The model to be developed is initially based on the notion of negative feedback derived from cybernetics, generalised to include a broader range of mutual causal processes.<sup>4</sup>

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<sup>1</sup> The assumption is one that is generally made in respect of approaches to meaning and meaning relations in philosophy and cognitive science, although some authors are more inclined to a bottom-up rather than a top-down approach. [See for example Dennett generally, and the discussion in Cummins 1996]. The assumption is innocuous to the extent that the implications for cognitive systems derived from higher order models, can be drawn out and tested.

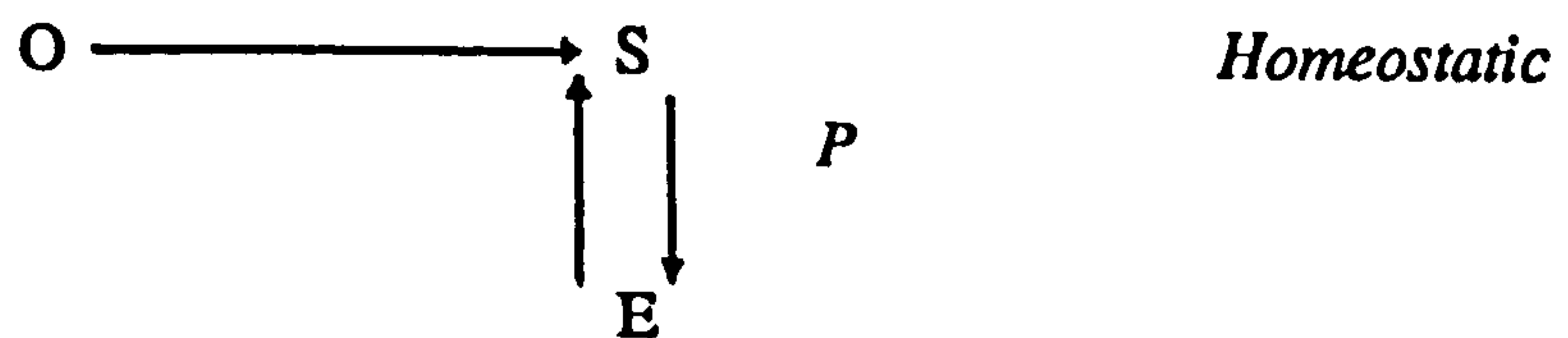
<sup>2</sup> The principal additional requirement of systems of sufficient complexity to engage the account, which are not brought out in product semantic accounts, are the possession of a memory capability of some description and the ability to distinguish between negative and positive experiences (in an adaptational context). These requirements are acknowledged as necessary to all accounts at this level of abstraction, and they will be assumed in the discussion which follows, but not explicitly represented in the model.

<sup>3</sup> Realism is not assumed in all product semantic accounts, and explicitly rejected in the form of the naive realism discussed by Krippendorff, so presumptions regarding the properties of the world external to the system will be initially restricted to expressions of aspects which are system-engageable or system-sensible.

<sup>4</sup> The principal aspects of the generalisation of the concept takes the form of the inclusion of deviation-amplifying processes and deviation neutral processes, in addition to deviation-counteracting processes (negative feedback); and loosening the constraint that the independence of the system and the environment can be secured a priori.

Models of this kind have a number of features which suit them to the purpose, notably that they can express interactions between systems and environments, and between systems, at a level of abstraction consonant with the level of the product semantic account; that they do not presuppose the concepts that we seek to elucidate, and they are implementable as scientifically characterisable physical systems.<sup>35</sup>

In order to set up the model, we will consider a simple interaction between a system and an environment. In the case of mammalian vision, overall retinal illumination is regulated by a negative feedback process. In response to an increase in illumination beyond a certain threshold, the pupil contracts, and the overall level of retinal illumination decreases as a result. Decreases in illumination result in dilation of the pupil and a concomitant increase in retinal illumination. The process serves to maintain the system in a viable operating state (some range of values of relevant system parameters), in the face of changes in the relevant variables constituting the operating environment of the system.<sup>36</sup> If we represent the operating environment as O, the system as P, the system parameter as S, and the available means of P effecting changes in the value of the system parameter as E, then the basic relation might be expressed as :-



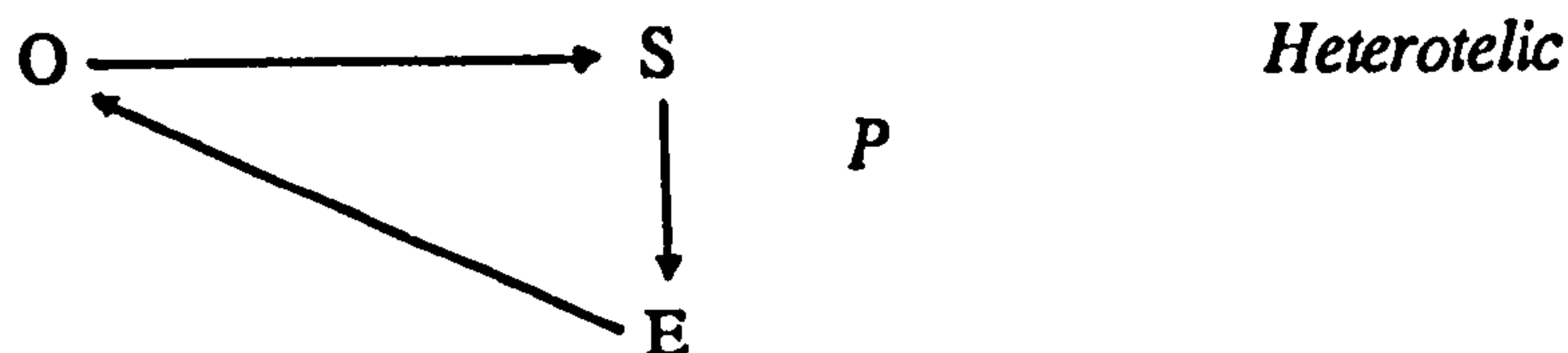
Systems of this kind are generally referred to as homeostatic since they sustain viable values of S through the operation of E within the system.

If S is a viable operating temperature, then in the homeostatic case, if the parameter S is sufficiently disrupted by the operating environment O internal mechanisms are brought into play which reduce the temperature and return S to a value within the viable range. As an alternative strategy the action of E can operate in altering the system's relation with O in order to sustain viable values of S, rather than directly re-balancing the value of S internally. So rather than invoking mechanisms such as capillary dilation and sweat gland activity, the action of E might be to move the system away from the source of heat.

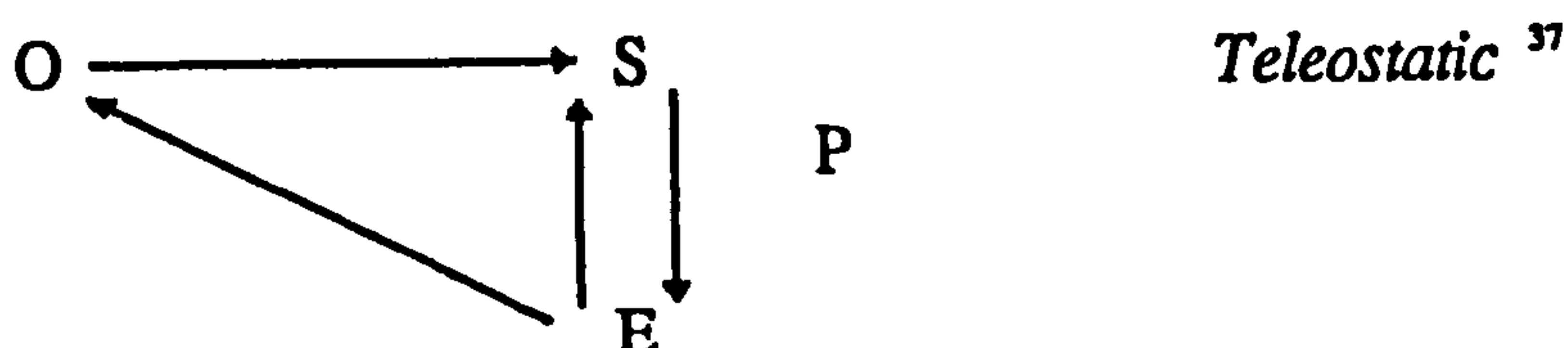
<sup>35</sup> The concept of homeostatic systems and negative feedback were developed by Cannon, [Cannon 1939] and applied more generally, particularly in the scientific characterisation of teleological concepts by a number of authors [Rosenbleuth et al 1943,1950; Wimsatt 1971; Manier 1971; Rescher 1970]

<sup>36</sup> Although the initial model presented here is expressed in terms of a separation between something defined as a system and something defined as an operating environment, and the distinction generally understood in terms of independent and dependent variables, the designations are relative, and in general the system and operating environment together, can be viewed as a system at a higher level.

This might be represented as :-

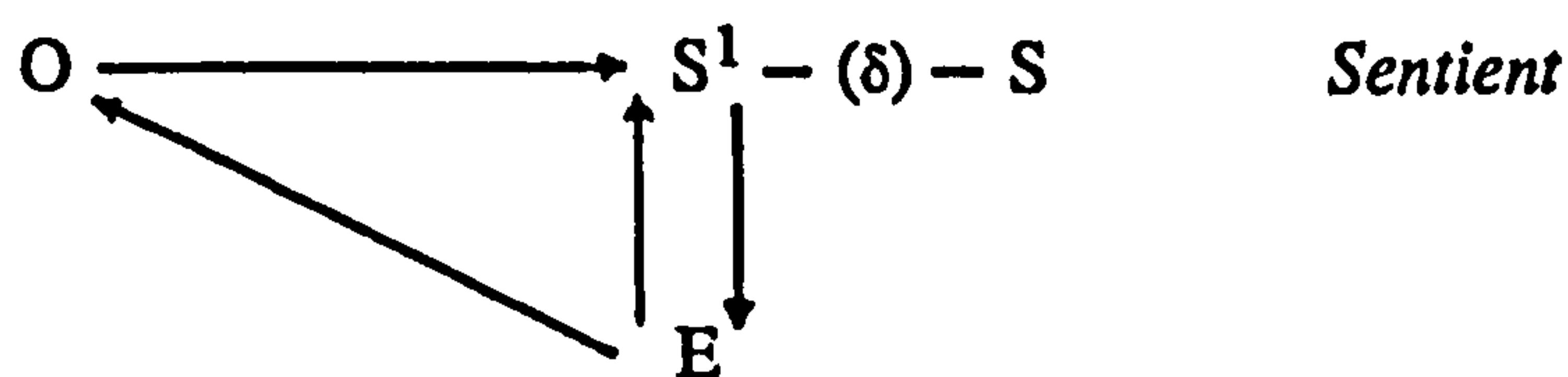


Clearly the two kinds of mechanisms are not mutually exclusive and in most systems they will co-exist as balanced strategies - in the presence of excess heat an organism may both sweat and seek the shade, and may need to balance these components of E in maintaining a viable value of S :-



The principal way in which simple interactions of this kind achieve complexity and sophistication is in the introduction of displacement or delay functions in respect of the terms of the relation.<sup>38</sup> The most obvious way in which this can take place is if the system state instantiating the parameter S is buffered by an alternative system state. The direct action of the operating environment on S can lead to radical destabilisation of the system. An adaptive advantage will potentially be gained by the system if the behaviours (E) it deploys relative to S are triggered by some other state S<sup>1</sup> which is systematically related to S, and whose stability is not as essential to the continued operation of the system as S.

This situation might be represented as :-



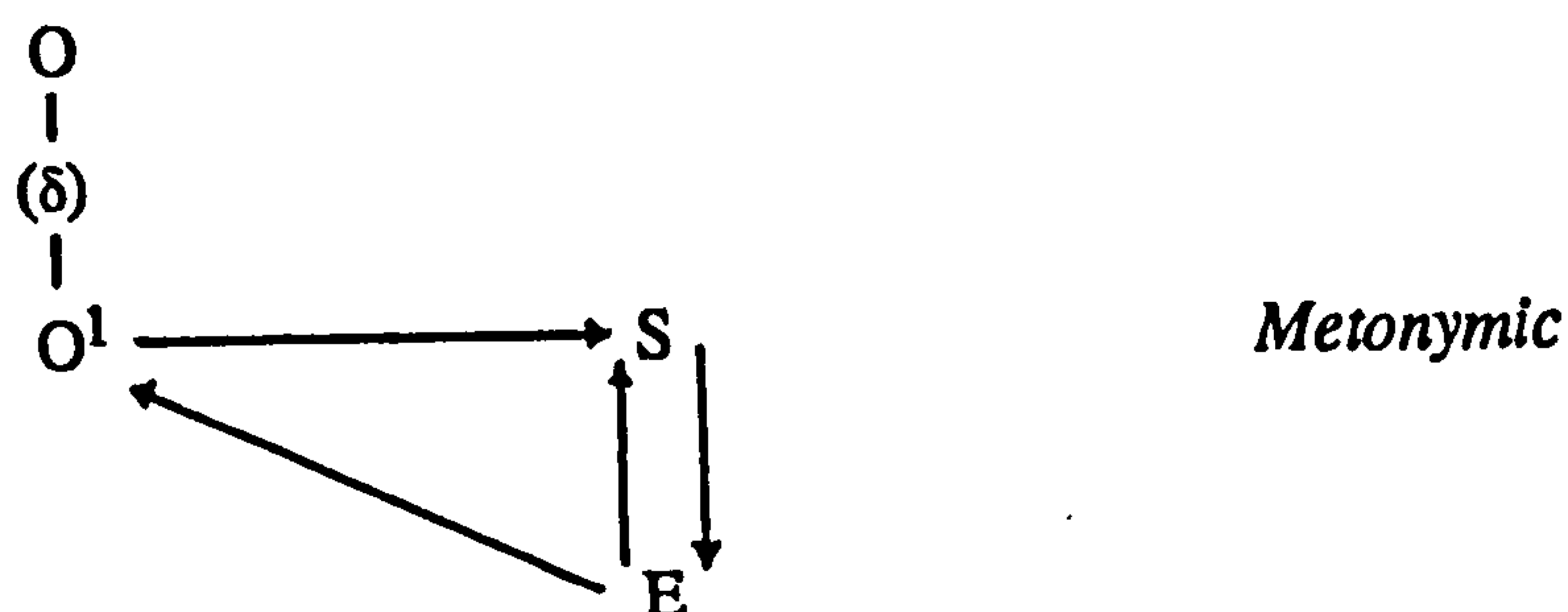
where  $\delta$  is a delay or displacement function.<sup>39</sup>

<sup>37</sup>The general terminology applying to systems in cybernetic accounts normally extends only to the homeostatic and heterotelic cases, which are the only forms normally modelled. Sayre extends the core account to cases of 'anticipatory' and 'sentient' interaction [Sayre 1976]. The remaining terms used here are coined to aid reference as the model is developed independently.

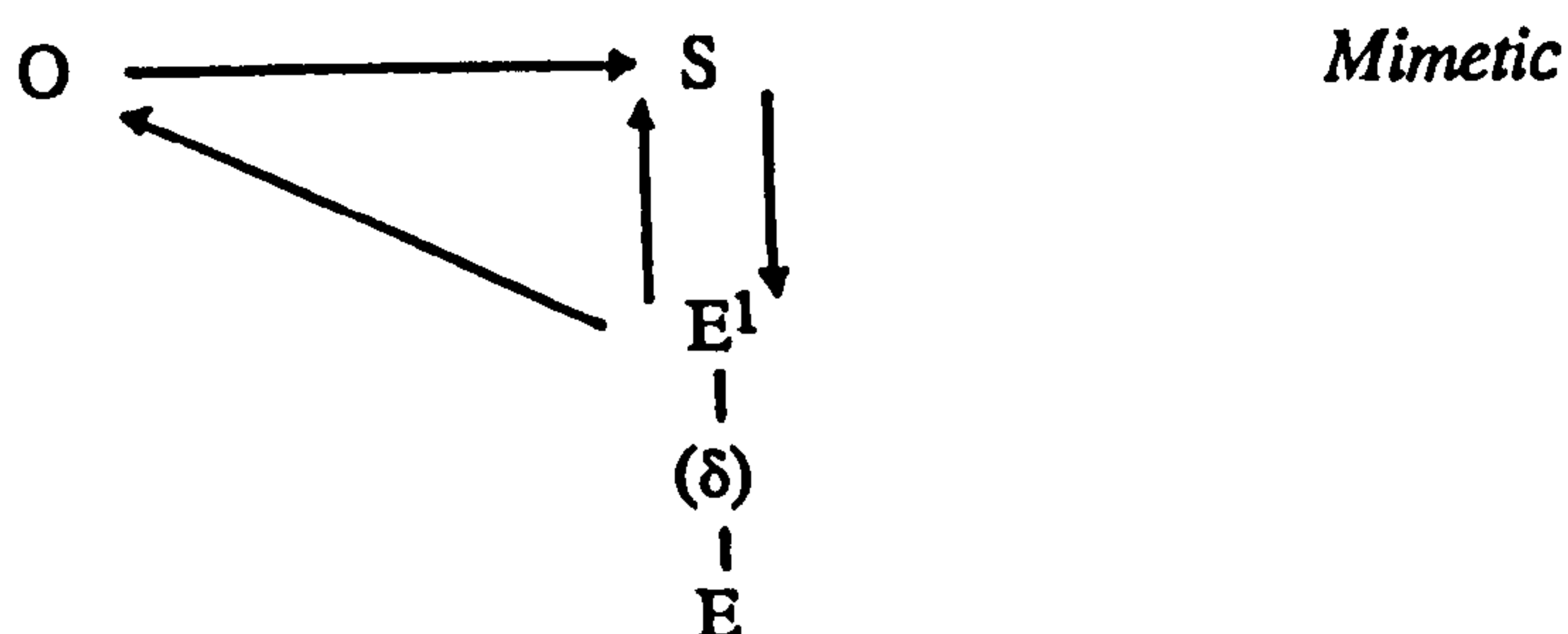
<sup>38</sup>For the purposes of developing the model, an obvious source of complexity will be ignored. This relates to the fact that a given system will have a number of coexisting system parameters and a number of effector complexes in its behavioural repertoire, which may have complex internal relationships and require mediating mechanisms to account for how internal accommodation is achieved. The general question of this form of internal complexity will be addressed at a later stage in the discussion.

<sup>39</sup>The simplest case will be where S<sup>1</sup> is physiologically related to S (a part of the complex constituting the instantiation of S as system states) but temporally precedes the remaining states of S.

If parallel displacement functions are introduced in respect of the other terms of the basic relation then two further independent possibilities can be represented <sup>40</sup>, one relating to the operating environment O :-



and the second relating to the effector complex E :-



Some sense of these can be gained as follows. In the case of the operating environment O let us suppose that O in fact consists of the conjunction of O<sup>1</sup> and O<sup>2</sup>. Some feature or property O<sup>1</sup> which is part of the complex might vary concomittantly with the whole in such a way that the system parameter S varies indifferently with respect to either O or O<sup>1</sup>, but does not so vary in respect of O<sup>2</sup> alone. In such a case the system may come to respond to O<sup>1</sup> rather than O.<sup>41</sup> A parallel argument can be applied in the case of the behaviours E elicited by the system. The essential criterion for the possibility of a displacement function is that the relation between O and O<sup>1</sup>, or E and E<sup>1</sup> should be isomorphic with respect to properties relevant to S.<sup>42</sup>

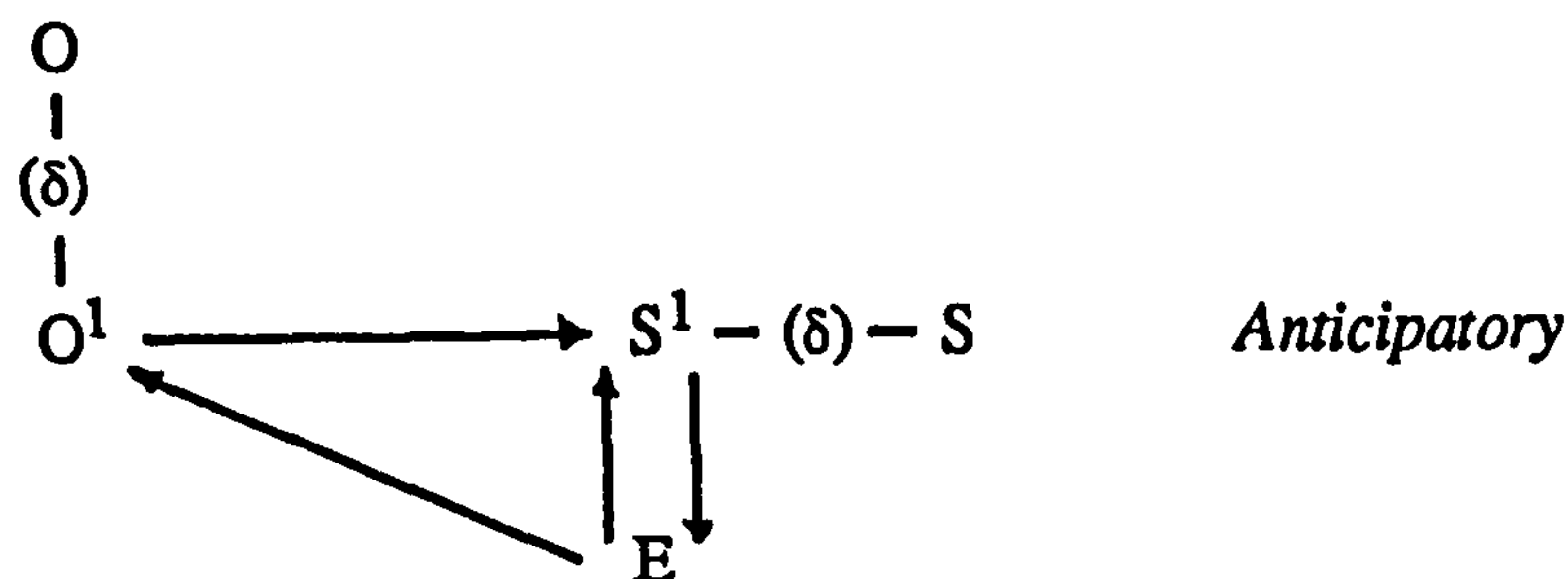
Although displacement functions can be separately expressed as independent possibilities for the basic triadic interaction model, in practice they are most often evident as

<sup>40</sup> It is not claimed that these representations can be meaningfully instantiated independently, but only that a parallel logic can be applied. It remains to be seen whether sense can be attached to them.

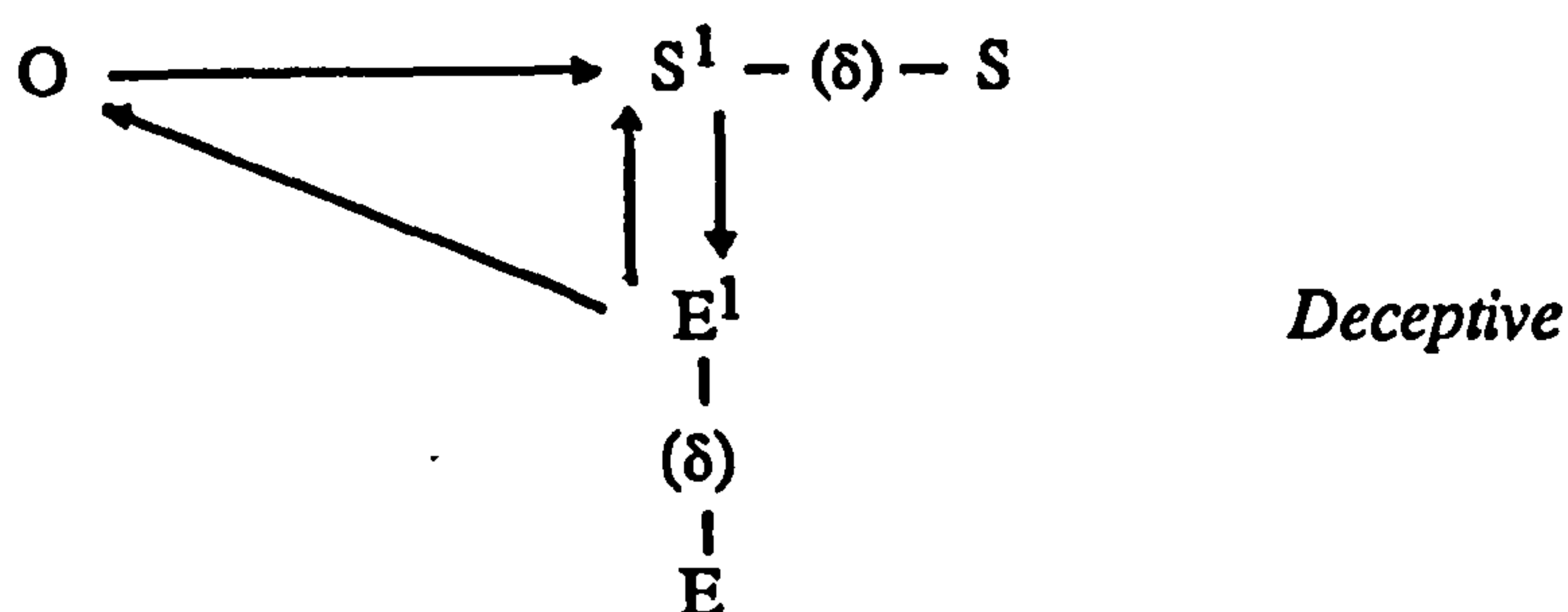
<sup>41</sup> Or may be viewed as responding to the one rather than the other. This is parallel to the disjunction problem in respect of the content of representational or functional states.

<sup>42</sup> An example of the former might include interactive processes such as immunisation, where a controlled or simulated infection triggers the system into preparedness for states which can counter full blown infection. The latter will include parallel cases in which epiphenomenal system products affect the operating environment.

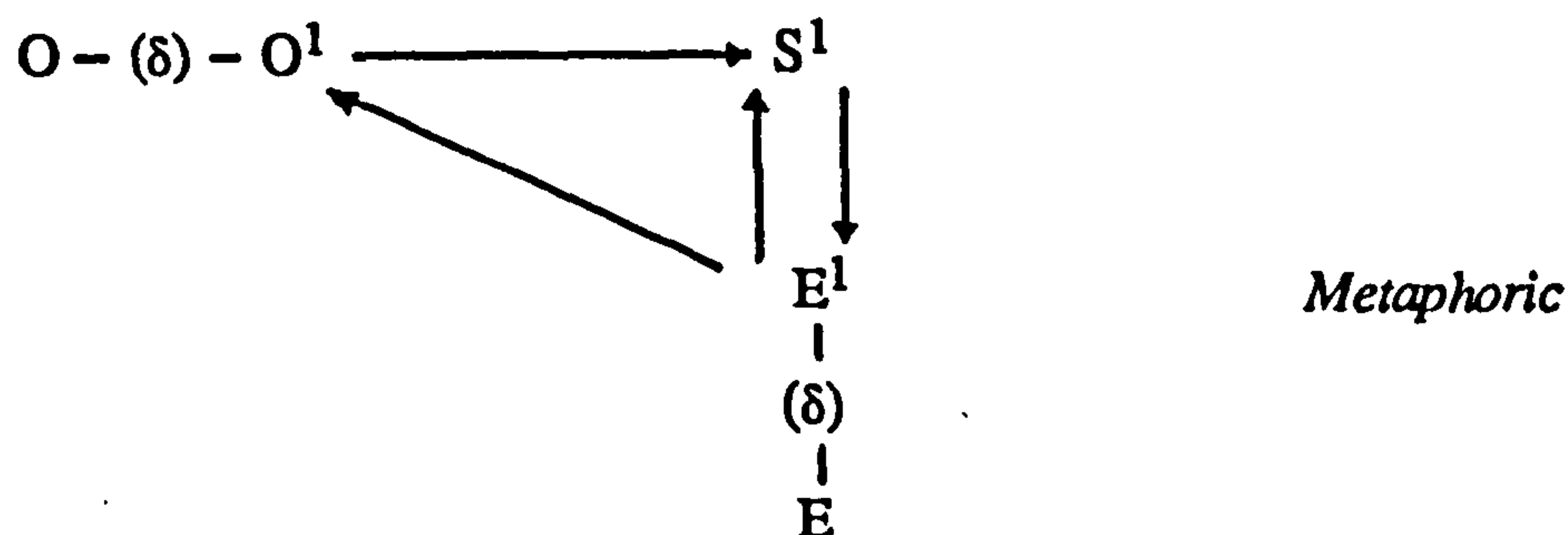
implementations when combined. The logical possibilities for their combination comprise three paired relations and one further composite relation. The first paired relation couples sentient and metonymic displacement relations :-



The second paired relation couples sentient and mimetic displacement relations:-



The third paired relation couples metonymic and mimetic displacement relations :-

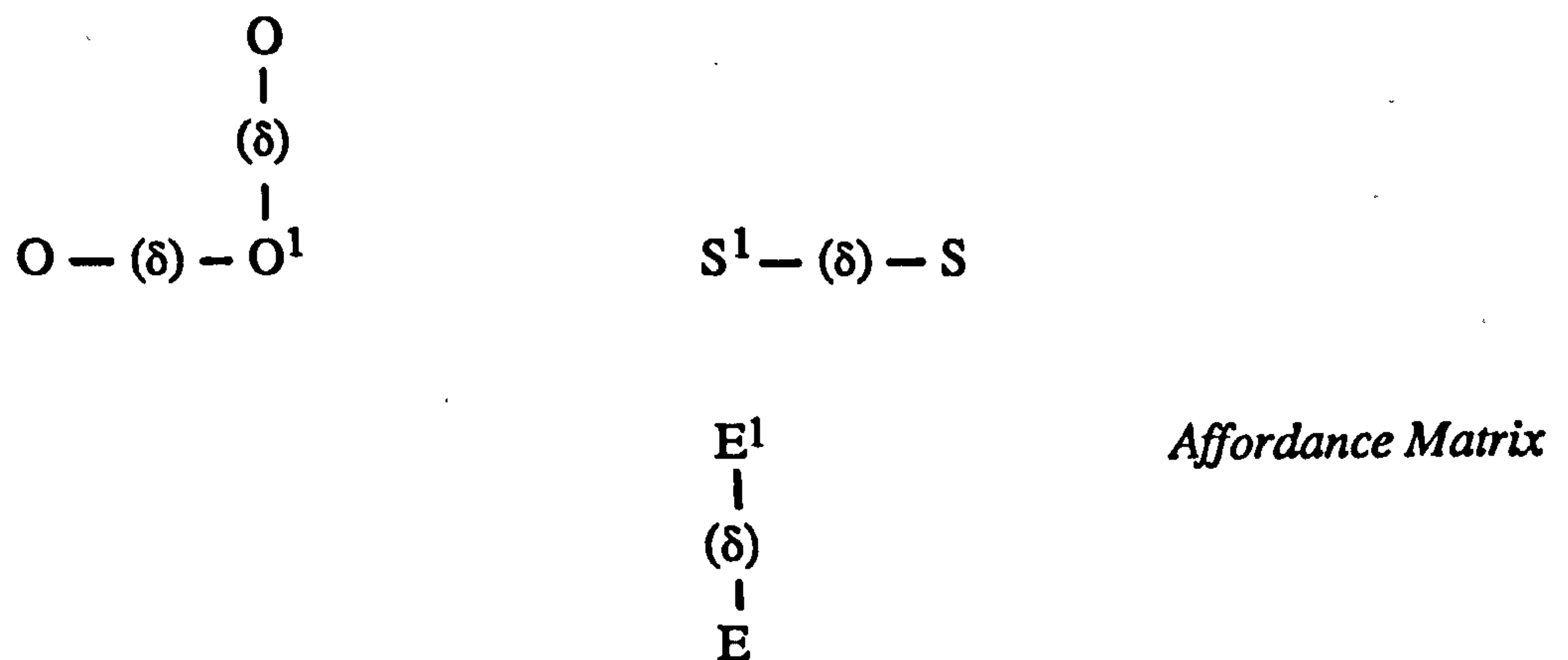


The first two paired relations are relatively easily exemplified as instantiated in physical systems. In the first case, there are many systems which in addition to buffering S internally also make use of operating environment parameters which covary with the system affecting states. In the second, there are also many systems in which a substitute behaviour comes to be effective in changing the relation with the operating environment.<sup>43</sup> The third paired relation (which conjoins mimetic and metonymic relations) is more difficult to place, since displacement in the terms of the relation occur in the absence of a

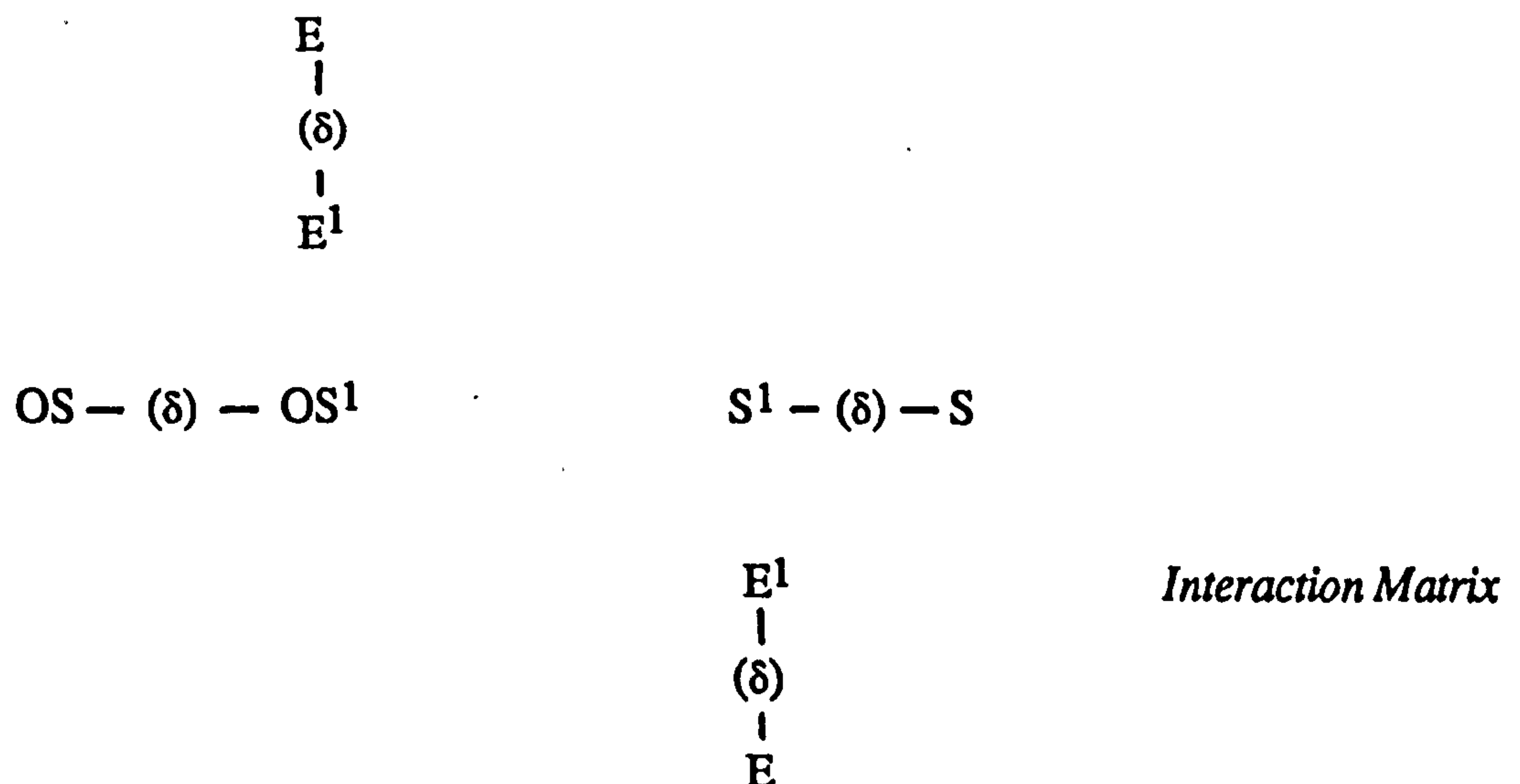
<sup>43</sup> Anticipatory behaviours and Deceptive behaviours are illustrated generally by examples which include territoriality defined in terms of visual and olfactory boundaries. A rich variety of examples can be found in studies of animal behaviour [for example Eibes-Eibesfeldt 1970; Hinde 1966].

sentient displacement relation. In this case there is a relation between a substitute or deceptive behaviour and a covariant feature or epiphenomenon of the operating environment, which is included here as a logical possibility whose significance will become apparent as the overall model is explored.

The composite relation (which superimposes the paired models) includes the possibility of displacement in all three terms,<sup>44</sup> and can be regarded as representing a matrix for plotting possible interactions and sub-relations :-



The case of interaction between two systems (for example interaction between two agents; or between an agent and an interactive system) can also be modelled on the same basis :-



<sup>44</sup>The duplication of the representation of the operating environment in respect of its relation with the system parameter S and the effector E, will be retained in the diagram for reasons which will become apparent later. Clearly the diagram could be reformatted as an equilateral triangle with equiangular branches, which would avoid this duplication.

### *Applying and Testing the Model*

The matrices derived for the system-environment interaction, and for system-system interaction will be used to model a number of paradigm cases illustrating different kinds and levels of interaction, derived by independent analysis, to test the model. The place marker symbolisation will remain as before, but in order to simplify the presentation, the displacement functions will not be explicitly represented; similarly only the 'heterotelic' relations will be illustrated initially, and 'homeostatic' relations introduced as required.

Three kinds of basic relation will be represented. a) *dependency relations*, represented with arrows, which are to be understood as generalisations of causal and logical dependency ( $S \longrightarrow E$ , which is interpreted as E is dependent on S); b) *associative relations*, represented as solid lines, which are to be understood as generalisations of metonymic and displacement relations ( $S1 - S$ , which is interpreted as S1 is associated with S); c) *virtual relations*, represented with dashed lines, which are to be understood as implied relations (either associative or dependent). Inoperative relations (dependency or associative relations not in effect at a given time) are represented with fine lines.

#### *System-Environment (Object) Interactions*

The model will by definition encompass accommodation in the case of the lowest levels of object relation since these are essentially homeostatic or heterotelic in character. Since the effective behaviours available to the system are not at this stage differentiated as to type, but are expressed as an unanalysed complex capacity, the behaviour components relating respectively to internal and external mechanisms are not distinguishable. The model will therefore also encompass teleostatic interactions in so far as these relate to the overall content of the system parameter, and differentially directed behaviour.<sup>45</sup>

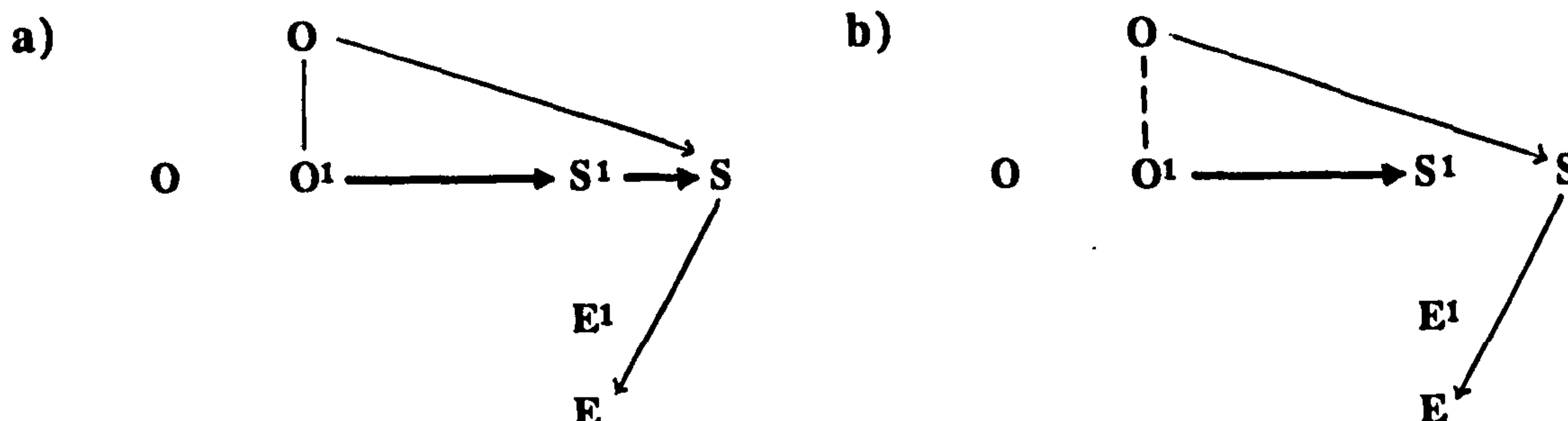
The principal descriptive application for the model at a testable level, occurs in the context of object interactions involved in behavioural development and learning, which are collectively exemplified by a group of related ethological concepts and examples. These are 'habituation', 'classical conditioning', and 'operant conditioning'. If the model is to be minimally sufficient for modelling system-object relations at a high level of generality, these concepts which are independently defined within the discipline of ethology, should be expressible in the model, distinguishable within the model, and differentially defined by the model in respects that map to the basis of their distinctions in ethological theory.

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<sup>45</sup>The essential limitation here, which can be extrapolated to each of the basic terms of the relation (E,O,S), is that the only way of distinguishing the fact that more than one component is involved, is in terms of the targets to which the components are directed - there are just as many components as there are targets. Since the model (at this stage) is only concerned with global relations, this is not a significant limitation.

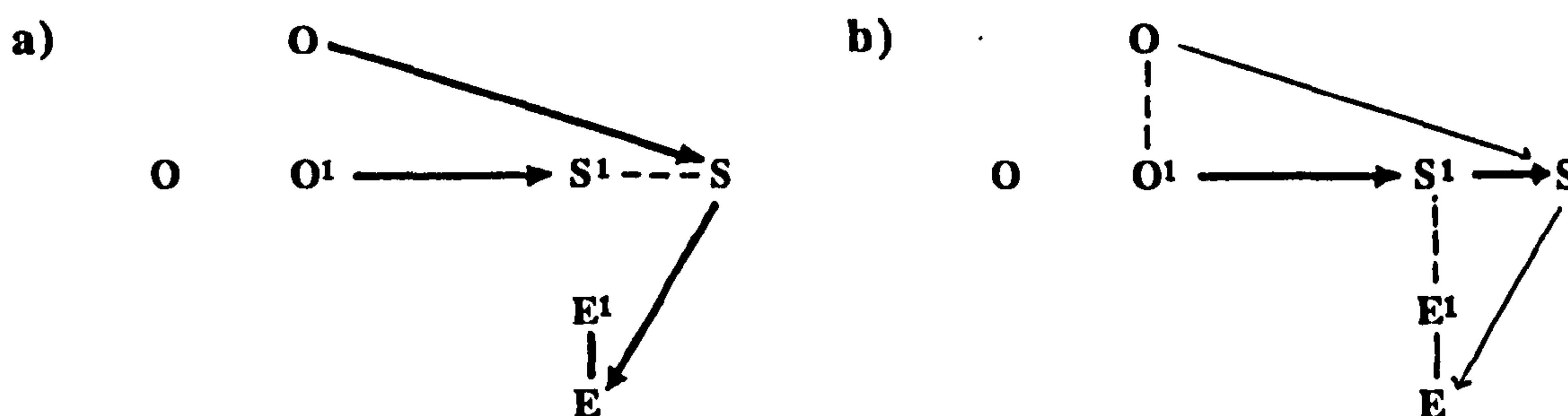


Habituation refers to the case in which an organism or system which initially reacts to some stimulus, will cease to respond to the stimulus if it is repeated in circumstances in which it is biologically inconsequential.<sup>46</sup> This would be represented in the model as follows :-



In a) the system parameter S consists of a complex which can be disrupted by certain states of affairs in the external environment. In the event that these are instantiated in some form O, the system will trigger a behaviour E. S<sup>1</sup> is a sensory function of S such that if O obtains, S<sup>1</sup> can detect O<sup>1</sup> and this is sufficient to prime S to trigger E. In b) if S<sup>1</sup> is repeatedly triggered by O<sup>1</sup> in the absence of the full relation of O to S, then S<sup>1</sup> ceases to be sufficient to prime S to trigger E.

Classical Conditioning refers to the case in which an established pattern of connections involving a stimulus environment and associated behaviours, can alter so that an alternative stimulus can trigger a particular behaviour independently from the normal stimulus-behaviour context.<sup>47</sup> This is represented in the model as follows :-

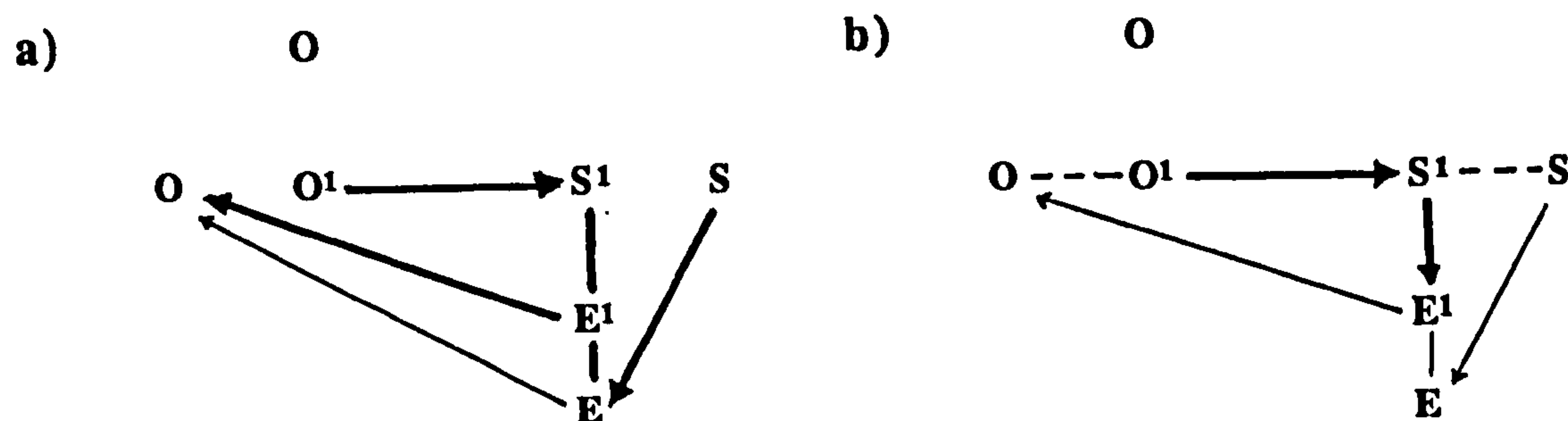


In a) the established pattern of connections is represented in the cascade from O - S<sup>1</sup> - S - E. Salivation E<sup>1</sup> is a distinct element of E. The associated (conditioned) stimulus O<sup>1</sup>, whose occurrence is systematically related to the occurrence of O, contributes to the input complex to S<sup>1</sup> (sensory function of S). In b) repeated association of O<sup>1</sup> with the cascade leads to E<sup>1</sup> being elicited by S<sup>1</sup>. The persistence of this substitute cascade is dependent on the original cascade (represented as virtual relations), and will decay unless the original cascade is reinforced.

<sup>46</sup> Eibl-Eibesfeldt 1970 pp 250-257.

<sup>47</sup> The locus classicus is of course Pavlov, and the most familiar example is the case in which the presence of food provides a stimulus environment which triggers a complex of behaviours, including salivation. If a bell is sounded at the time that food is presented, then the sound of the bell becomes part of the stimulus environment triggering salivation, and will come to be capable of triggering salivation per se.

Operant Conditioning refers to cases where there is an existing behavioural repertoire which is elicited in relation to a general system parameter, which has become established as a behaviour through its association with some external goal. Some component of the behaviour will be selected for if it is regularly associated with the achievement of the goal. If some consistent environmental condition is sensed, which is associated with eliciting the selected behaviour, then this will come to elicit the selected behaviour independently.<sup>48</sup>



In a) established behaviour E satisfies some general system parameter S (through past association with the virtual relation E-O). E<sup>1</sup> is a particular behaviour that is part of E. If some environmental condition O<sup>1</sup> is sensed by S<sup>1</sup> and generally occurs where E<sup>1</sup> is in a relation with O, then in b) E<sup>1</sup> will come to be elicited by S<sup>1</sup> in response to O<sup>1</sup>. The behaviour will decay unless the original cascade (represented as a virtual relation) is reinforced.

### Discussion

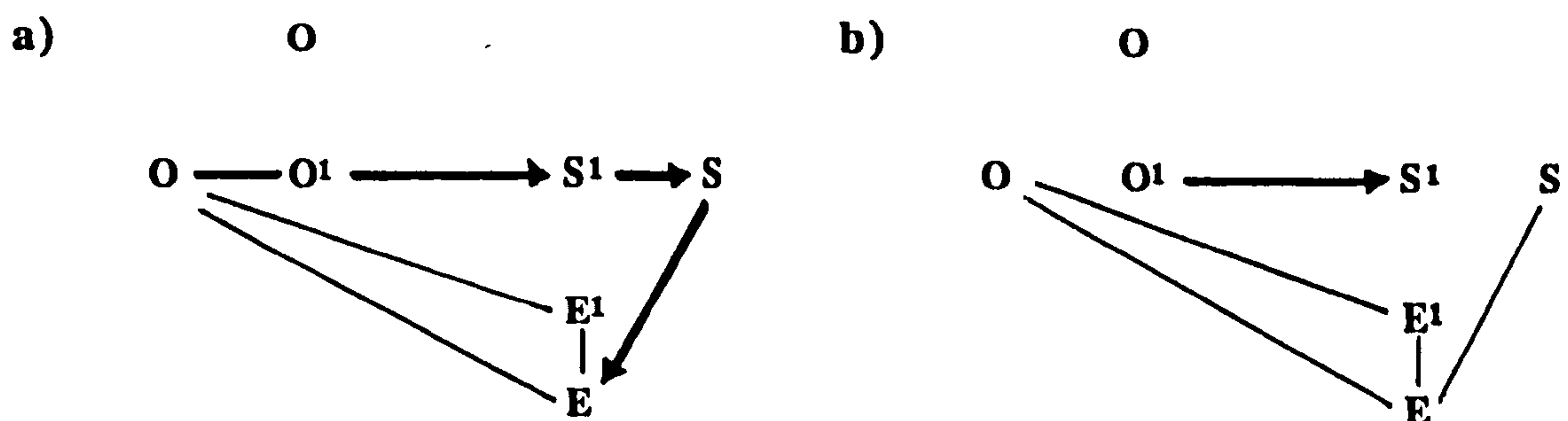
The model is capable of expressing a range of related object interactions at a high level of generality and in distinguishing these in terms of the patterns of directedness in the relations obtaining. Comparison of the cases as expressed in the model, implies a number of similarities and differences. In all three cases a pre-existing system parameter/behaviour relation is presumed, which grounds the developing behaviour and remains as a background relation relative to the developed behaviour. In the negative case of habituation, no virtual relation is implied. In the positive cases different virtual relations are implied.

Cessation or suppression of responses can be distinguished from changes of response in the course of an interaction, in terms of whether virtual relations are implied. Differences in the kinds of developing response relations can be determined in terms of two factors - the relative pattern of dependent and implied virtual relations that are established; and the distinction between the source of grounding of the pre-existing system parameter-behaviour relation, in the content of the operating environment as either input or output related. These determinants are sufficient to distinguish the range of related behaviours.

<sup>48</sup> Skinner 1938,1953.

The model implies that the pre-existing relation in operant conditioning is grounded in an output relation, and predicts that the key dependent relation will obtain between a sensory input and a partial behaviour with virtual relations implied in respect of the operating environment and an associated independent environmental factor, and between the system parameter and an associated independent sensory function. In contrast the model implies that the pre-existing relation in classical conditioning is grounded in an input relation, and predicts that the key dependent relation will obtain between the system parameter and an independent sensory function, with virtual relations implied between the operating environment and an independent environmental factor, and between a sensory function of the system parameter and a partial behaviour. The differences are consonant with the ethological accounts in both cases, and the model provides a basis for the explanation of the differences in scope of the two forms, in learning and in shaping behaviour. Since the dependent relation established in classical conditioning is mediate between some stimulus from the operating environment and the system parameter, and the partial behaviour is only in virtual relation with the stimulus, the implication would be that the shaping of behaviour consists in controlling the conditions under which a given behaviour is elicited. In contrast the dependent relation in the case of operant conditioning connects the stimulus with the partial behaviour, short circuiting the relation with the system parameter, to which it is only virtually related, implying that the behaviour can be shaped independently, which is in fact the case.

In addition the logic of these examples suggests that further hypothetical cases could be constructed. A hypothetical relation derived from the model for operant conditioning was mapped onto the matrix and a definition derived from the resulting relations.



In a) there is some sensible feature associated with the operating environment which is registered by  $S^1$  and sufficient to trigger the pre-existing cascade  $S-E-O$ . b) If the cascade ceases to end in  $O$  when  $O^1$  is registered then the relation between  $O^1$  and  $O$  will be broken, and  $S^1$  will cease to be sufficient to trigger the cascade.

Consideration of the ethological literature reveals that a set of relations of this kind exists in a variant form of habituation relating to operant conditioning, termed extinction.

Consideration of these cases reveals a number of limitations of the model. The model is indifferent with respect to the nature and embodiment of the system parameter (S), which in some cases, for example, appears analagous to a stimulus input mapping and in others is more readily interpreted as a goal representation. This is a limitation to the extent that one is concerned with the mechanisms through which behavioural complexes are elicited, and the criteria under which they are elicited or withheld. A parallel limitation is apparent in respect of the behavioural complex (E) and the operating environment (O). Since the product semantic account seeks to provide an account of meaning in terms of perceive-affordance, and the latter, though composed of a complex of sensory and behavioural interactions, is conceived as holistic and relational at the system level, the model should be capable of providing the basis for the requisite distinctions, without breaking into the substructure of these major components. This limitation will therefore be accepted as a positive feature of the model.

In some cases greater discrimination would clearly be achieved if additional displacement functions were included in respect of the major components of the model, and in fact there is no logical bar to the use of these in the model. The advantage of using a single displacement function to represent some distinctive feature of each of the components, and allowing the remainder to be bundled up as undifferentiated complexes, lies in the achievement of a higher level of generality, and simplicity of presentation. (Where it becomes impossible to achieve distinctions of type, additional displacement functions will be introduced).

The third significant limitation of the model concerns the available representation of kinds of relations. There is no discrimination between distinct kinds of associative relation (for example between metonymic, co-spatial or co-temporal association). Similarly there is no discrimination between different kinds of dependency relation (for example between causal and logical dependency) and more particularly no discrimination in respect of the valency of the dependent relation. Distinctions of this kind would be necessary in the discrimination of particular behavioural interactions (for example in discriminating between riposte and appeasement), but should not be required to model the general case of relational interaction consonant with the aim of the product semantic account expressed at its most abstract level.

The model will therefore be accepted without modification or extension at this stage and applied in respect of interactions between systems, rather than between a system and an environment or external object.

### *System-System (Individual-Individual) Interactions*

The approach used in considering the interaction between a system and an operating environment (external object) can also be applied in modelling the interaction between systems, (or between individuals, or between individuals and interactive systems).

It should be noted that the system-operating environment (object) relations considered to this point have been modelled on the tacit assumption that mutual causal processes can be generally represented using the paradigmatic case of negative feedback. It is particularly clear in the case of interacting systems (although also true of environmental or object relations), that this assumption cannot be sustained.<sup>49</sup> In many cases the result of interaction may take the form of escalation rather than accommodation. Mutual causal processes generally can be either deviation-counteracting, or deviation-amplifying, or may consist of a complex of such processes, whose overall effect may take one form or the other, or be neutral with respect to deviation.<sup>50</sup> In general, the key classes of deviation-amplifying cases relevant to the current discussion can be modelled within the framework of catastrophe theory, in which deviation-amplification can be shown to lead to a cycle involving a number of displaced equilibrium positions and associated hysteresis conditions which bring interacting systems back into deviation-counteracting or deviation-neutral states.<sup>51</sup> Although the importance of modelling of this kind can be readily acknowledged in the explanation of both local and global sub-processes,<sup>52</sup> in so far as they apply in the interactions under consideration in the current discussion, they do not impinge on relations at the current level of analysis since their effect is to return the system interaction to an overall deviation-neutral or deviation-counteracting condition.

The principal descriptive application for the model in respect of system-system interactions at a testable level, occurs in the case of conspecific and interspecific behavioural accommodation. In this case the model will be applied to concepts and examples drawn from ethological and semantic theory namely 'motor pattern imprinting', 'conspecific territoriality', 'behavioural accommodation', and 'non-natural meaning (Grice)'.<sup>53</sup>

Motor pattern imprinting is an imprinting-like learning process which occurs in relation to behaviours for which there is an innate disposition. This disposition requires activation during a critical period of development for a given species, which typically takes the form of performances of the behaviour by a mature member of the species. If the performances to which the learner is exposed are part of a sufficiently similar behavioural repertoire but

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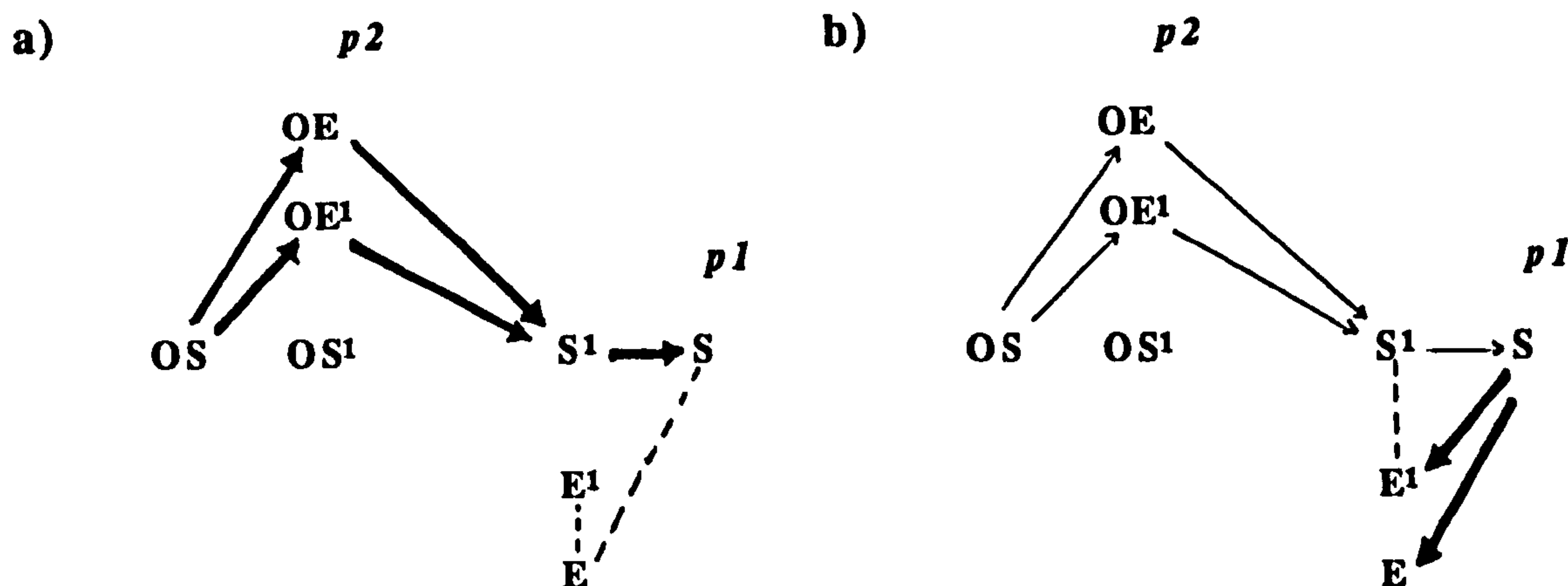
<sup>49</sup> For example hypersensitivity reactions, and superstimuli.

<sup>50</sup> Morphostatic and morphogenetic processes [Muruyama 1963].

<sup>51</sup> Zeeman 1977; Zeeman and Isnard 1977; Thom 1969.

<sup>52</sup> Muruyama 1963.

elicited by another species, then this alternative motor pattern will be imprinted.<sup>53</sup> This would be represented as :-



In a) there is an innate disposition for p1 to elicit a range of related behaviours (indicated by the virtual relation S-E), and an actual range of behaviours in the conspecific p2 (OS-OE), or the alternative (OS-OE<sup>1</sup>). Realising the disposition as an actual behaviour requires S<sup>1</sup> registering a performance. In b) the behaviour actually realised (S-E or S-E<sup>1</sup>) will depend on whether the performance registered is OE or OE<sup>1</sup>.

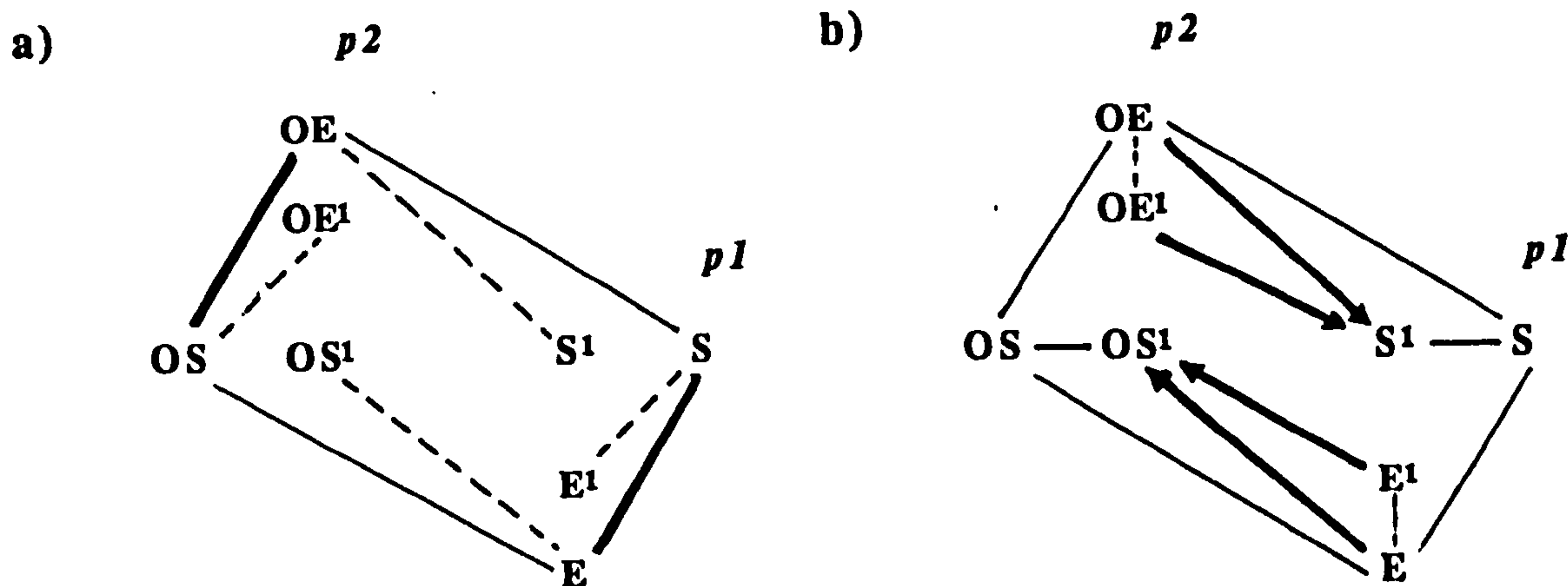
As an example of a richer and more typical case, and to introduce the model for the general class of system-system interactions, we will consider the interaction between two individuals of a species in respect of territoriality. In the case of interacting systems (individuals) without displacement functions, the relations will be conducted wholly in terms of direct physical interaction, with predictable consequences for at least one of the individuals involved. Where adaptive displacement functions are present, they will typically be evident in the form of sensory systems (S<sup>1</sup>-S relations), and partial or substitute behaviours (E<sup>1</sup>-E relations). The operating environment will again be taken to consist solely in the other individual.<sup>54</sup>

Conspecific territoriality includes a broad range of interactions operative at different levels of complexity. At the lowest level this will comprise direct interaction between the physical behaviours of systems and system parameter complexes. These can take the form of behavioural accommodation or behavioural escalation, but commonly consist of a dynamic pattern of these states. The generalisation of these relations can be modelled by expressing mutual dependency between relata. In many systems (species), developed sensory capacities mediate the interaction, allowing for anticipatory conditions which

<sup>53</sup> Eibl-Eibesfeldt 1970 pp 225-232.

<sup>54</sup> The fact that both individuals have relations with the environment in which they coexist will be ignored for the present.

become coupled with partial behaviours, which prefigure physical interaction. The general case is represented as :-



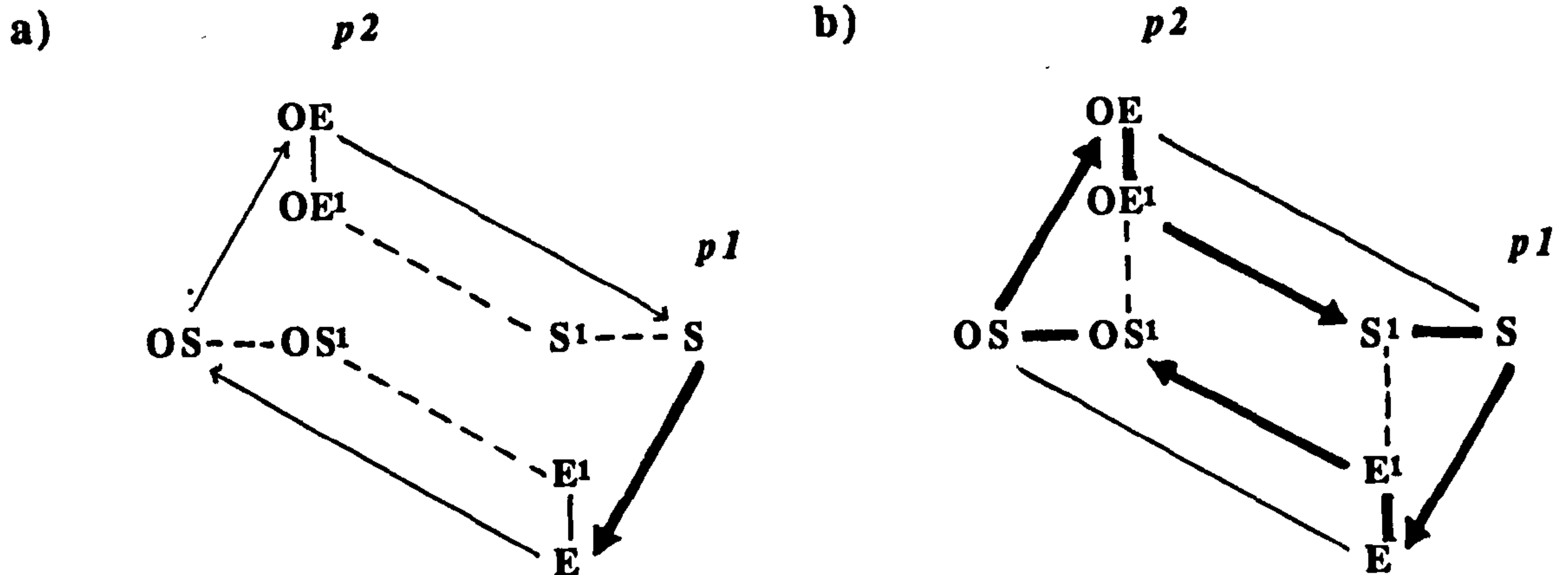
In a) mutual dependency relations obtain between behavioural repertoires and system parameter complexes. The presence of specific sensory capabilities ( $S^1$  and  $OS^1$ ) allow inter alia for anticipation and triggering avoidance reactions relative to the other individual ( $E-OS^1$  and  $EO-S^1$  represented as virtual relations). The ability to deploy partial behaviours allows for the capacity to threaten or appease ( $E^1-OS^1$  and  $OE^1-S^1$  also represented as virtual relations). In b) all available relations are implemented. In practice the complex of interaction will oscillate between real and partial behaviours, the remaining relations existing as virtual relations which come into play as the cycle changes.<sup>55 56</sup>

An everyday example of interspecific behavioural accommodation is furnished by the kinds of interactions that take place between a dog and its owner, in preparing to go for a walk. Aspects of the person's general behaviour will be perceived and interpreted by the dog as signals for the extended sequence 'going for a walk'. This will interact with the dog's system parameter complex (whether the going for a walk mindset is in place and has a positive or negative valence) and trigger preparatory behaviours in response, which might take the form of rushing to the front door or slinking off behind the sofa. The complex of behaviours may include learned sequences (the dog sitting still and inclining its head in preparation for a collar to be put on) which can act as signals to the owner, and can come to stand independently as an intentional indicator.

<sup>55</sup> A complete complex cycle of interaction could be represented using the model, in the form of a temporal sequence of move by move transitions in the matrix (stop-frame model). It is assumed that the possible sequences of steps are sufficiently clear in the composite diagram for this to be avoidable.

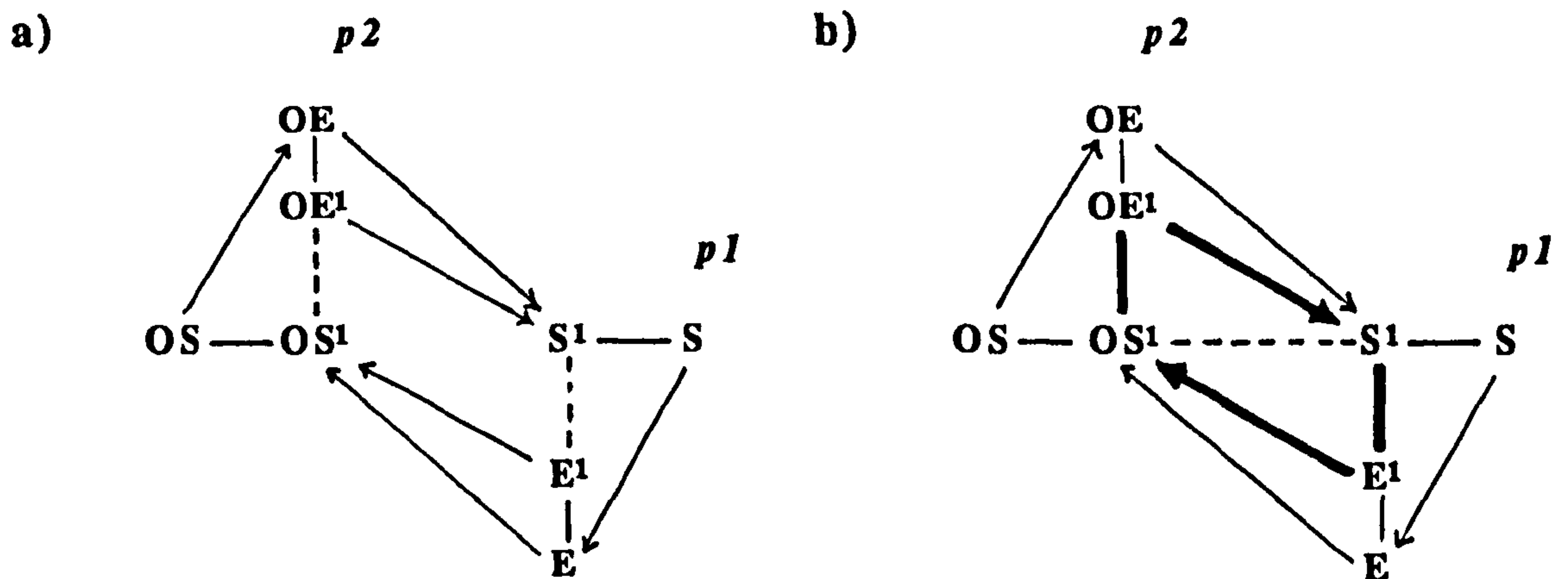
<sup>56</sup> Examples of this range of territorial behaviour are common. In many species of fish, for example, a typical cycle might include accidental incursion into a territory, provoking an attack and flight reaction. As the distance between individuals increases, this will be perceived by the chaser who disengages. The pursued may then turn towards the chaser, who perceives this anticipatorily and deploys a threatening behaviour, which may turn into a further attack if the pursued does not turn away.

The general case for examples of this kind are represented as :-



In a) the system parameter  $S$  takes the form of decision by  $p1$  to engage in an activity  $E$  which is part of a familiar cascade of accommodation relations between  $p1$  and  $p2$ , (represented as virtual relations). In b) an initial part  $E^1$  of the activity  $E$ , is registered by the sensory system  $OS^1$  of  $p2$  and through interaction with the system parameter  $OS$  elicits behaviour  $OE$ . Part of this behavioural complex  $OE^1$  is registered by  $p1$ , and for example acts as a confirmatory or disconfirmatory cue relative to  $S$ .

A higher order of communicative interaction is exemplified by Grice's account of the nature of non-natural meaning and its relation to natural meaning in human communication.<sup>57</sup> The general case is represented as follows :-



In a) there is an established behavioural relation between some experienced state  $S$  and an action or set of actions  $E$  for  $p1$ , which can be perceived by  $p2$ . A parallel set of states exists for  $p2$ , which can be perceived by  $p1$ . Some element  $E^1$  of the set of actions can be independently employed by  $p1$  with the intention that it should be registered by  $p2$ , who replies with the behaviour  $OE^1$  (with the intention that it be registered by  $p1$ ). In b) the generalised case is a set of relations operating through displacement functions, against the background of virtual relations representing the grounding behaviours.

<sup>57</sup> See above pp 213-214.



## *Discussion*

A parallel range of conclusions can be drawn in the case of system-system interactions as for system-environment interactions. The model is capable of expressing a range of different types of behavioural accommodation at a high level of generality, and distinguishing between these in terms of the patterns of dependent, associative and virtual relations. The limitations of the model in system-system interactions, however becomes more acute, since the limitations apparent for a single system are duplicated in the interacting system. The model will again not discriminate forms of accommodation (for example in terms of the valence of interactive relations), or differences in the actual form of implementation of the system parameter (innate complexes versus acquired complexes) behavioural complexes or sensory complexes. Taken together these imply an inability to discriminate levels and kinds of cognitive activity, or indeed to distinguish cognitive activity from the general run of system functions. However, these limitations of the model are reflective of the programme derived from the product semantic account, whose core concern must be to ground perceive-affordance and meaning, and related concepts at the highest possible level of generality, and therefore at the lowest possible level of discrimination.

The strategy adopted will therefore be to apply the model in attempting to characterise affordance, perceive-affordance and meaning and related terms including communication, representation and content, and to determine what additional discrimination is required and at what stage in the process, in order to complete the characterisation. Clearly, since it is likely, given the full range of product semantic expressions of these concepts, that the characterisation will need to encompass intentionality and the nature of concepts and categories, the major components of the current model will probably require augmentation with a richer vocabulary and a more complex syntax. Nevertheless it should in principle be possible, if the intuitions guiding the product semantic account are along the right lines, to establish the basis for these concepts at a high level of generality.

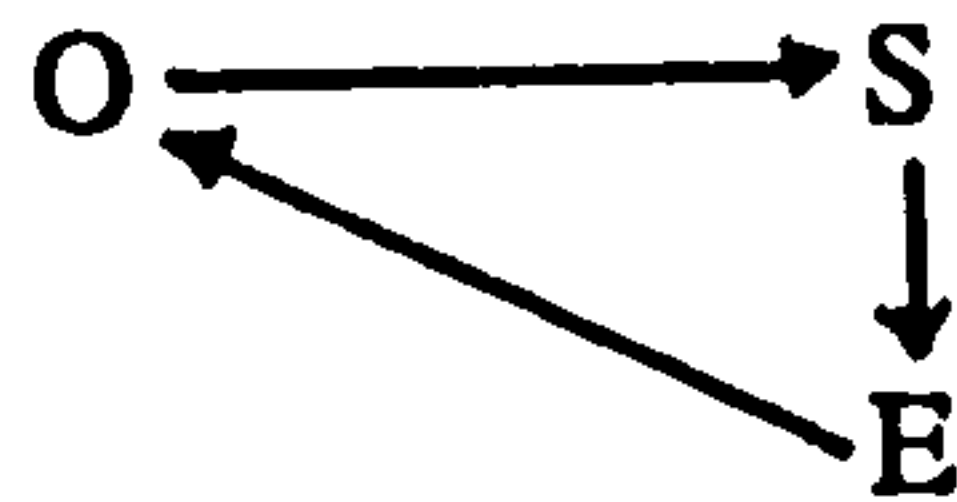
In addition, if the rejection of the key forms of dualism is taken seriously, then it should be possible to demonstrate the way in which the foundation for the higher levels of abstraction are continuous with a basic position in which subject-object and perception-cognition distinctions, for example, are not assumed.<sup>58</sup> The importance of such a programme is the central role that it reserves for an experiential and situation-centred semantic account, rather than an essentially propositional account, which leaves the key questions relating to the nature of experience unsupported.

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<sup>58</sup> Even though these distinctions are used to set up a description of the situation in which they are not assumed.

## *Affordance*

The basic relation with the environment (generalised as an object relation) is represented in the form of heterotelic interaction and can be regarded as the lowest level of implementation of an affordance relation.



This is so to the extent that S and E are systematically related and co-developmentally adaptive.<sup>59</sup> An affordance relation at this level implies that the behaviours deployable by the system are sufficient to maintain the system parameter within a viable range in respect of the relevant states and changes of state of the operating environment. If they are insufficient then the relation that obtains is not an affordance. An affording environment or object is one in which the states and changes in state of the operating environment are such that they accommodate the system parameter in terms of deployable behaviours of the system.<sup>60</sup>

Although the cybernetic model has typically been used to characterise basic homeostatic and goal-seeking processes and behaviours in terms of negative feedback, it is not in principle restricted to these. The model can be applied more generally. In the case of a simple hypothetical system, for example, the system parameter might take the form of continued movement in a given direction (towards the light), and the behaviours deployed might include a range of limb movements. The operating environment, which in this case consists of a flat plane with a number of shallow steps, is in itself unchanging. In terms of the interaction however the relation is relativistic - the encounter might equally be expressed in terms of changes in the operating environment or in terms of changes to the system.

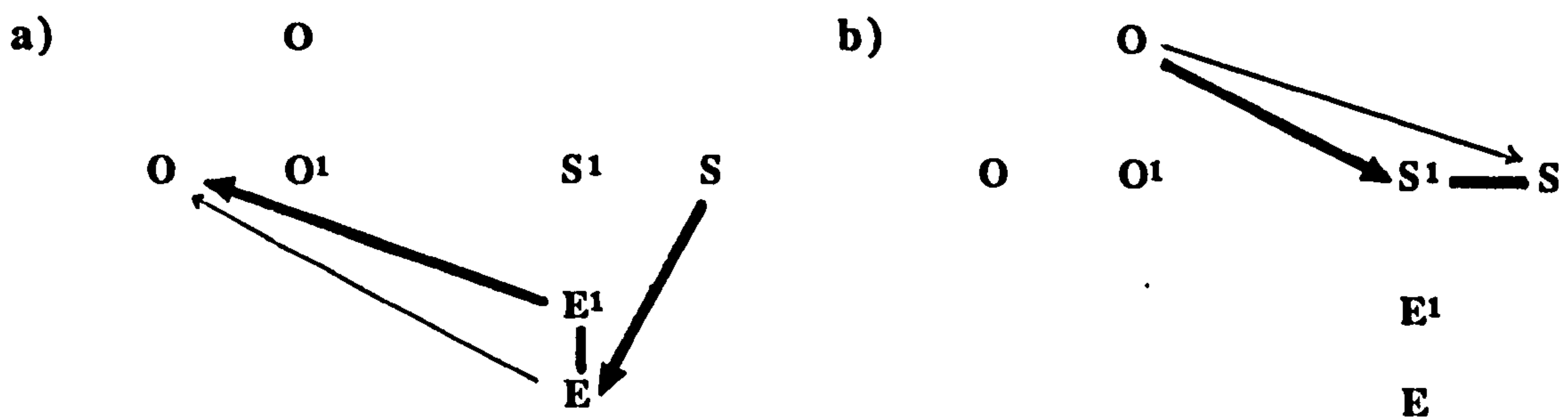
An expression in terms of the characteristics of the operating environment, requires an external frame of reference (a means of independently registering the shape of the environment and the behaviour of the system), and although it is natural to assume that

<sup>59</sup> A constraint of this form is not sufficient to imply that the complex instantiated as the relation S -E constitutes an entity, since it can be shown that these properties are demonstrated by certain kinds of buffered physical systems in which co-development of elements simulates adaptivity. Examples of these kinds of system are explored in Wimsatt 1971. Although the failure to find decisive differentiating criteria has been leveled as a criticism of the integrity of the concept of feedback, it could equally be argued that one ought to expect continuity between buffering/displaced accommodation among the elements of physical systems, and feedback in simple organisms.

<sup>60</sup> This reading of 'affordance' is consonant with the basic sense proposed by Krippendorff. The affordance relation applies to the totality of the interaction, but can be viewed and expressed in terms of either the characteristics of the operating environment or the goals and capacities of the system.

such a frame is available, because we are able to see it in these terms, it is not automatically available to the system. The system 'experiences' the change in the environment as it moves forward, as differential changes in the behaviour it can deploy. There is a sense then that in so far as such a system can be said to register its environment, it does so in terms of patterns of deployable behaviour. In so far as the system also has a sensory capacity (a displacement function relative to S), then this will also result in registrations taking the form of patterns of internal change.

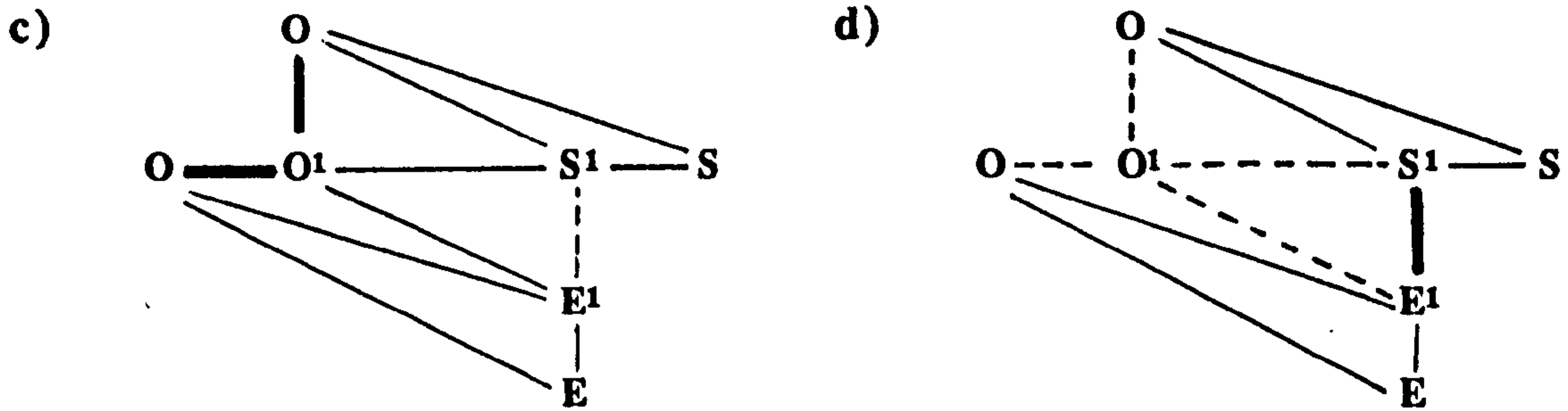
There are essentially two basic ways in which environmental registration can take place. The first consists in registering the differential deployment of behaviour. The second consists in sensory registration (some value of the displacement function relative to S). The characterisation of species in terms of affordance (by an external observer), consists in specifying the range of environmental properties that can be sensorily registered, taken together with the differential deployment and registration of behaviours relative to the environment. For the system there are two independent forms of registration, which together constitute a relation of affordance with the environment, which are functions of O-S and O-E respectively.



In a) E is deployed as a routine behaviour in response to S. In an encounter with the operating environment (a step), E is interrupted and in fact only E' can be deployed. O at this juncture is registered in the differential between E and E'.

In b) S' is a sensory parameter which is a function of S (light orientation) registering patterns of light and dark. O at this juncture is registered in the detection of an interruption of the light field (cast shadow of the step).

An affordance or integrated interaction with the environment (co-adaptivity), involves the association of the sensory registration S' with the behavioural registration E', in respect of the relevant properties of the environment. However, we are still in a position where the system can only register the environment as values of its own internal states, even though these are now co-registered.



In c) the displacement of E to E<sup>1</sup> and the registration of S as S<sup>1</sup> yield a complex for the registration of the operating environment, in the form of O<sup>1</sup>, which viewed externally can be regarded as a complex function of aspects of O.

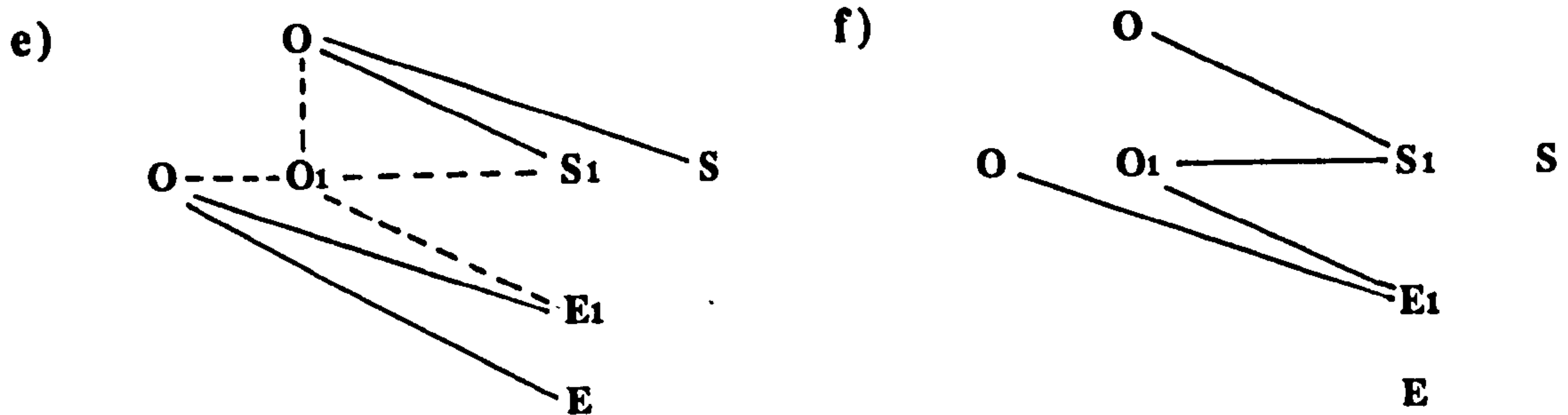
In d) however, viewed internally, it is clear that the complex O<sup>1</sup> is only indirectly a function of the aspects of O, but directly a function of the co-ordination of S<sup>1</sup> and E<sup>1</sup> which are functions of the aspects of O.

The sense of perceive-affordance at the level of object encounter on the product semantic account can now be characterised in terms of the use of registrations to infer affordances. In the case of the simple model outlined, this is equivalent to inferring or projecting E<sup>1</sup> on the basis of the relation between S<sup>1</sup> and O<sup>1</sup>, or inferring or projecting S<sup>1</sup> on the basis of the relation between E<sup>1</sup> and O<sup>1</sup>. At this level, perceive-affordance is directly equated with meaning in product semantic accounts and constituted in terms of a complex of significations which in this simple and one-dimensional system are equivalent to the contents of S<sup>1</sup> and E<sup>1</sup> respectively. S<sup>1</sup> and E<sup>1</sup> are also taken to be representational for the system elements S and E, in respect of their contents. Perceive-affordance is itself representational in that O<sup>1</sup> is a complex content derived from the co-ordination of the contents of S<sup>1</sup> and E<sup>1</sup>. However whilst these latter contents are available only to the system elements of which they are a function, perceive-affordance is the representational construct which is available to the system. The hierarchy of relations in the model are therefore consonant with the role of affordance in Teleological Semantics.<sup>61</sup>

Having introduced the idea of 'content' and 'representation' to the model, it is possible to gain some initial purchase on these concepts, by looking at the relations in the interaction from both an internal and external perspective, as a prelude to later discussion. As we have seen S<sup>1</sup> and E<sup>1</sup> have functions in relation to the system parameters S and E, and are said to be representational for those system elements. This is the case in so far as they can have values which are differentially effective in the deployment of those system elements,

<sup>61</sup> See above pp 125-129.

in the operation of the system. However in respect of the case of  $O$  and  $O^1$  considered in c) and d) above, it was possible to derive distinct forms of representational relation which if generalised for the interaction would yield :-



In e) **internal perspective**,  $S^1$  and  $E^1$  are functional for  $S$  and  $E$ , and representational in virtue of having content. But this content is constituted in the displacement of the relations  $O-S$  to  $O-S^1$  and  $O-E$  to  $O-E^1$  respectively. Similarly  $O^1$  is a representational construct derived from the co-ordination of  $S^1$  and  $E^1$ .

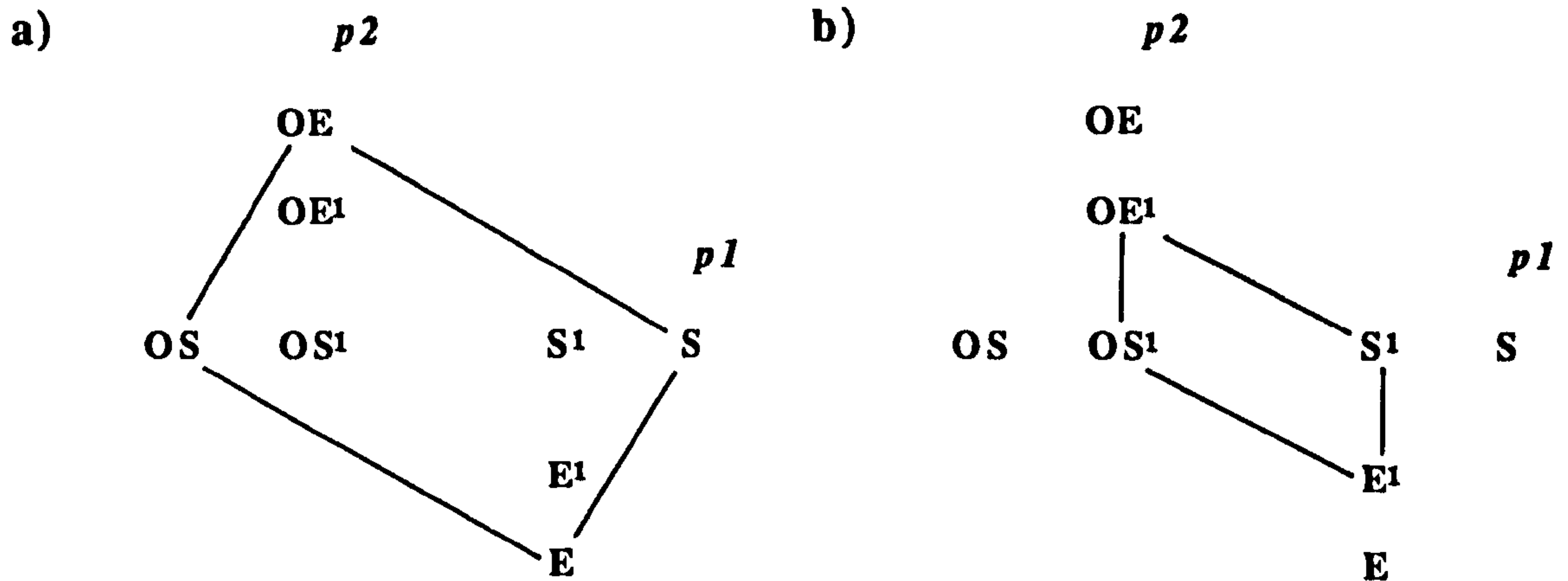
In f) **external perspective**, it is possible to view  $O^1$  as representational of  $O$  for  $S^1$  and  $E^1$  respectively. Similarly,  $S^1$  can be viewed as representational of  $O$  in respect of  $S$  and  $E^1$  as representational of  $O$  in respect of  $E$ .

From an internal perspective, representation is dependent on the functional role of a displacement function for the system element to which it relates. Unless functional role is defined in terms of content, then it is independent of particular content and dependent only on having some content, whatever that might be. Something is representational for the system purely in terms of the fact that a functional role is instantiated by a system element being given some value. From an external perspective, on the other hand, something is representational to the extent that it is possible to derive a mapping from a relation, and this is independent of the functional role of the system element involved in the relation.<sup>62</sup> There are then two basic ways of characterising representation (and content) one defined in terms of functional role and the other in terms of a mapping relation. The third possibility is that functional role might be defined in terms of content, which gains its sense from a mapping relation.

<sup>62</sup> To take an example. We are presented with a drawing which appears to be a drawing of a bus, but which we are told by the artist is in fact a chair. There are two stances we can take. We can say that it is a representation of a chair because for the artist it has the function or role of representing a chair, or we can say that it represents a bus in virtue of its mapping relation as an image to buses.

### *Affordance and Interaction*

A parallel approach can be taken in respect of system-system interaction (interaction between individuals) yielding the limiting cases of interaction which can be represented as follows :-

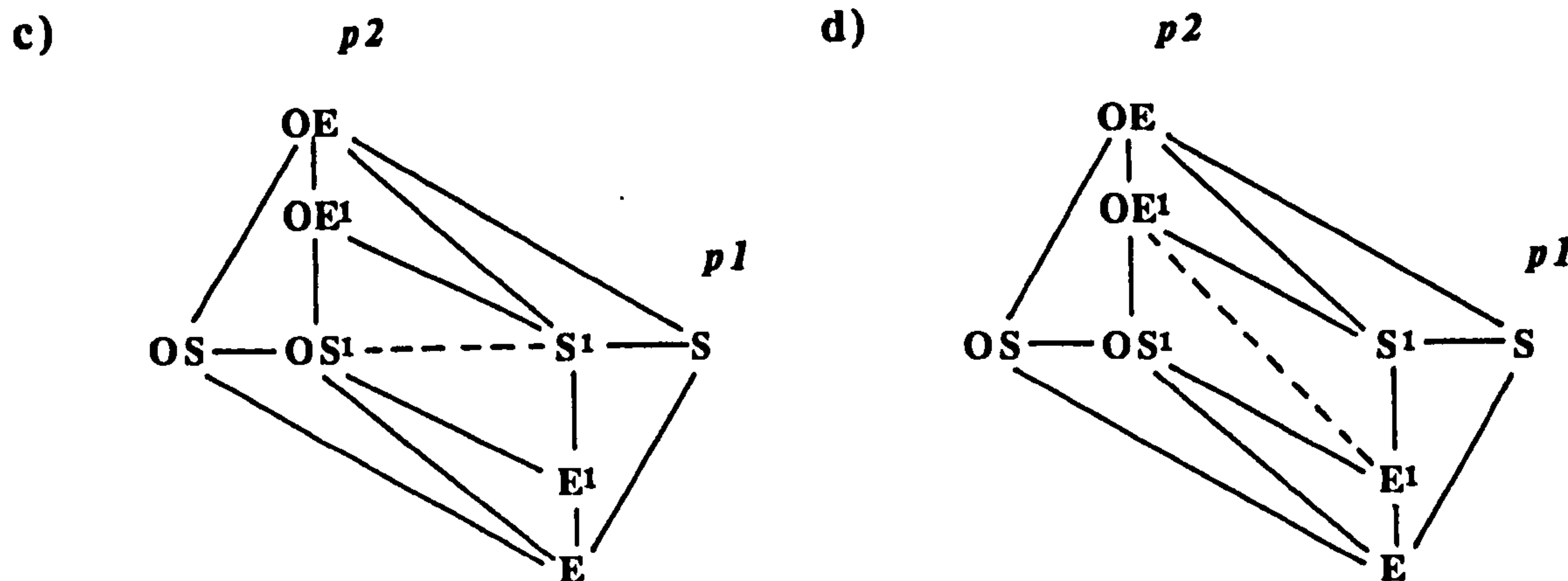


The examples delimit the two extremes of a continuum for interacting systems - one (a) illustrating the baseline physical interaction between two systems, the other (b) illustrating an interaction which is entirely conducted in terms of displacement functions. On the basis of the previous discussion of system-environment relations, the first can be characterised as a basic affordance relation in terms of co-adaptational criteria, and the second as the highest (most abstract) level of perceive-affordance.

In the case of two interacting systems, achievement of an affordance relation implies the coordination of behaviours rather than accommodation between a behaviour and the operating environment. Although this can in principle be achieved via the direct physical interaction between systems, coordination will again be facilitated by the presence of displacement functions. This is evident in the case of a displacement function taking the form of a sensory capability, and particularly so where this is coupled with a displacement function which allows for the deployment of partial or substitute behaviours. The various possible combinations of displacement relations constitute intermediate positions in the continuum circumscribed by the two limiting cases illustrated in a) and b) above.

One way of viewing this would be to regard the lower level limiting physical case as basic with more complex interactions (levels of perceive-affordance or co-ordination) arising as virtual relations which become instantiated. As they become instantiated, so the possibility

of new virtual relations emerges in a continuing process of 'semantic ascent'. At the highest level illustrated here, virtual relations are implied between  $S^1$  -  $OS^1$  (c) and between  $E^1$  -  $OE^1$  (d).



### *Meaning*

Perceive-affordance in the case of interacting systems is constituted in the co-ordination of sensory and behavioural functions, in the interaction between the two systems. Since in the product semantic account perceive-affordance is equated with meaning, meaning is also a function of co-ordination. However the product semantic account views meaning as an individual construct, which is prior to and in-principle independent from interaction. On the latter view it is a construct through which co-ordination occurs, rather than a construct that results from co-ordination. We are all capable of constructing meanings, and these happen to be capable of co-ordination because the cognitive basis of our meaning making is a parallel mechanism that we all share. In terms of the model the sense of this would be that there is some mechanism deployed in a certain way by an individual relative to the external environment, that is possessed and deployed in the same way by other individuals. There is a way of making content and meaning which we share (in the sense that we all have the same mechanism), and this ensures sufficient co-ordination for interaction and communication.

The interaction model suggests that this is an unlikely explanation. The principal reason is that meaning relations on this facet of the product semantic account would be relations between internal contents, whose co-ordination forms the basis for external co-ordination. But in the model, relations of this kind are virtual relations - constructs that arise out of dependent and associative relations, but which are not constituted directly as interactions

in themselves.<sup>33</sup> This suggests that meaning as a function of communication cannot be based on the stability of system contents established in object or environment interaction.

Product semantics suggests that meaning is the form of our engagement with the world - we perceive the world in terms of meanings. Meanings are individual cognitive constructs equated with perceive-affordances.<sup>34</sup> Meanings are also the cognitive contents which enable communication to take place, suggesting that the highest level virtual relations currently represented in the model have the force of real relations. On the face of it there are no grounds for making this move, since semantic ascent (the move from virtual relations to dependent or associative relations) is achieved by harnessing some physically realisable relation, and it is difficult to see how this might be the case where the virtual relation is a direct relation between system contents. The model therefore suggests that at the high level of abstraction implied by the philosophical and theoretical commitments made in product semantic accounts, it is not possible to operate consistently with a single underlying conception of meaning, which is compatible with both an operational context and a communication context, neither is it possible to equate meaning directly with a single conception of perceive-affordance.

### *Summary*

The principal conclusions that can be drawn from mapping to the model can be summarised as follows :-

- a) There are two distinct sources of meaning relations, one grounded in the active presence of an organism in interaction with a physical environment, the other grounded in the coordination of behaviours between active individuals.
- b) An affordance relation modelled between an organism and its physical environment is realised as complex of system states comprising the values for a given sensory function and a given effector function.
- c) Perceive-affordance in the context of an affordance relation between an organism and its physical environment is a condition in which the value of either a sensory function or

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<sup>33</sup>There are two principal reasons for rejecting this tack which are independent from the conclusions drawn from the model. The first is that even in a case which is deterministic, divergence rather than co-ordination will tend to occur. This is so because of the sensitivity of systems to initial conditions. The second is the argument which forms the core of the Wittgensteinian programme in the *Philosophical Investigations*, to the effect that there is no external fact that justifies a given content, or co-ordination.

<sup>34</sup>In the extended sense of perceive-affordance implied by the rejection of a sharp distinction between perception and cognition.



an effector function (separately) allows an inference to a complex associated with an affordance.

d) An affordance relation modelled between individual organisms is realised in an individual as a complex of system states comprising the values for a given sensory function and a given effector function, where these are functions of the corresponding values of the correlated system states of the interacting individual.

e) Perceive-affordance in the context of an affordance relation between individual organisms is a condition in which the value of either a sensory function or an effector function (separately, or jointly) allows an inference to a complex associated with the interacting individual.

f) The complexity of higher level meaning can be hypothesised to stem from the interaction between the two sources of meaning relations, in the assimilation of representational content to signals, and the association of significatory functions with representational content.

## Appendix D A Methodological Implementation

In order to explore the content of the product semantic framework from a methodological perspective the elements will be mapped to a design process model. The design process model selected as a matrix for the mapping is based on the generalisation of a commonly used iterative scheme whose structure broadly matches the product semantic conception of the prevailing paradigm. The design process is represented in such schemes as sets of relations and transformations between function, structure, context and behaviour in the derivation of the design description (product specification).<sup>1</sup>

### *Design Process Matrix*

The scheme is based on the cumulative mapping of pairs of relata in terms of the minimally necessary conditions for an effective sequence leading from an intention embodied in a design brief to a realised product. Thus for example, a common general model of the core of the design process consists in the idea of a transformation from function to structure (F->S), or from function to design description (F->D). Such transformations are indirect, in the sense that mappings from one to the other involve mediating relations. In the case of F->D, for example, the mapping involves the idea that functions be instantiated as structure in order to be implemented as a design description (F->S->D). Similarly the relation between function and structure is mediated in terms of behaviours (albeit in a more complex way). A given structure will yield a set of actual behaviours (dispositions, properties) Bs. The implications of a set of functions can be specified in terms of a set of expected behaviours (dispositions, properties) Be. The indirect relation (F->S) can then be described in terms of the reciprocal mapping between

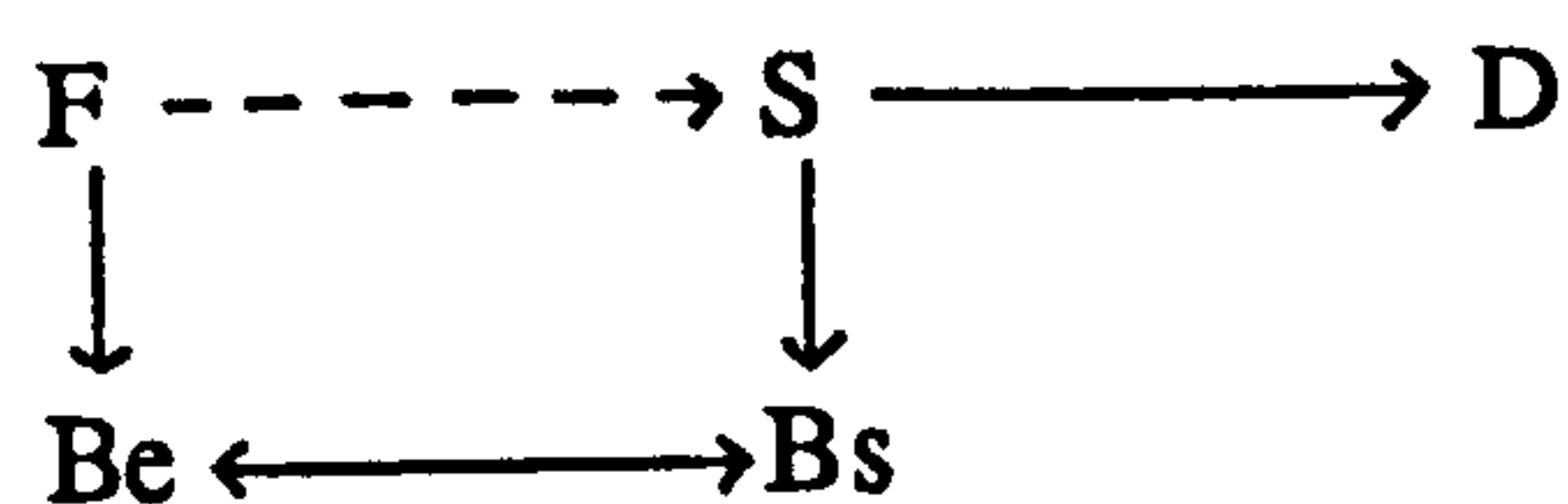
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<sup>1</sup> See above Section 11.2, pp 356-358. The particular form of implementation of the scheme is based on the model developed in Hybs and Gero 1992. This version of the semi-formal scheme was developed as a basic model which could be used to explore the viability of an evolutionary process model for design. The evolutionary aspect of the scheme is ignored in the current discussion, and a modified version of the basic matrix is adopted as a working model. [See also Gero 1990; Umeda et al 1990; Purcell and Gero 1991; Gero, Tham and Lee 1992; Sturges 1992; for the general development of the elements of the scheme]

The core of the scheme is compatible with a wide range of process models and generalises effectively across different forms of implementation [including for example Asimov 1962; Mesarovic 1964; Archer 1965, 1970; French 1985; Pahl and Beitz 1984, Yan 1993]. In the form presented by Hybs and Gero, the basic relations used are of two kinds - comparisons and transformations, and the process is represented as essentially linear, iterative and progressive.

The modification of the scheme employed here differs from Hybs and Gero in two principal ways. In the first place the relation of comparison is generalised in the form of the more inclusive relation of transaction (mutual interaction). The effect of this is to allow for mutual change relations, other than those conceived as formal comparisons. Secondly, the overall status of the matrix when instantiated with values for some or all of the elements is conceived as a general synchronic description, rather than a diachronic description. A diachronic version of the representation would then consist in a sequence of such synchronic representations (a sequence of representations of the matrix showing changes in the values of elements resulting from its operation). This allows the scheme to represent variations in the implementation of the matrix, accommodating a broader range of process models [eg Darke 1979; Lawson 1980; Tovey 1986; Goel 1996]. It is also thus possible to represent different cognitive styles, as differences in synchronic patterns, implemented diachronically.

Be and Bs ( $Be \leftrightarrow Bs$ ). The partial general model can be represented as :-



which assimilates the following paired relations (including indirect relations), (a):-

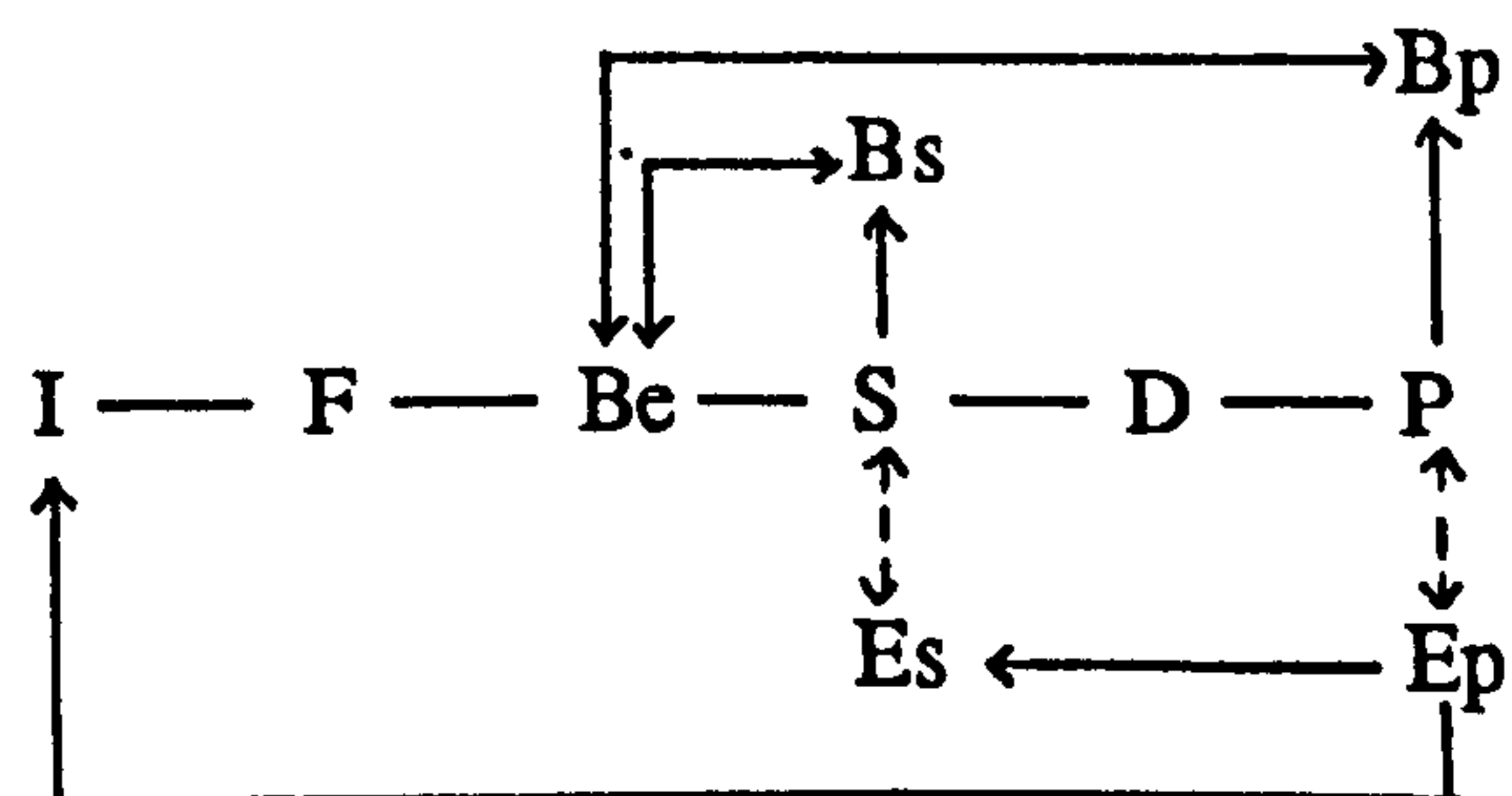
1	F->Be	Specification
2	S->Bs	Analysis
3	Be<->Bs	Evaluation
4	S->D	Design Description
5	Be->S(Bs)	Synthesis
6	S->Be	Reformulation

This partial general model requires contextualisation in a number of ways. In the first place it will be clear that the behaviours (dispositions, properties) of a given structure are context dependent, in the sense that the behaviour exhibited by a given structure will depend on the environment (E) in which it is placed, so that  $(S \leftrightarrow Es) \rightarrow Bs$ .

A further context against which the overall process is set consists in the existence and behaviour of real world products P (either pre-existing or as the outcome of the design process), which will again require relativisation to the contexts or environments in which they exist, yielding a parallel structure  $(P \leftrightarrow Ep) \rightarrow Bp$ .

In addition, it is assumed that the set of functions driving the process are derived from the intentions of the designer (for example in the form of the design brief), which are in turn derived from some subset of the real world environment of products. This might be expressed as a general relation in the form of the cascade  $Ep \rightarrow I \rightarrow F$ .

Incorporating these elements into the scheme yields :-

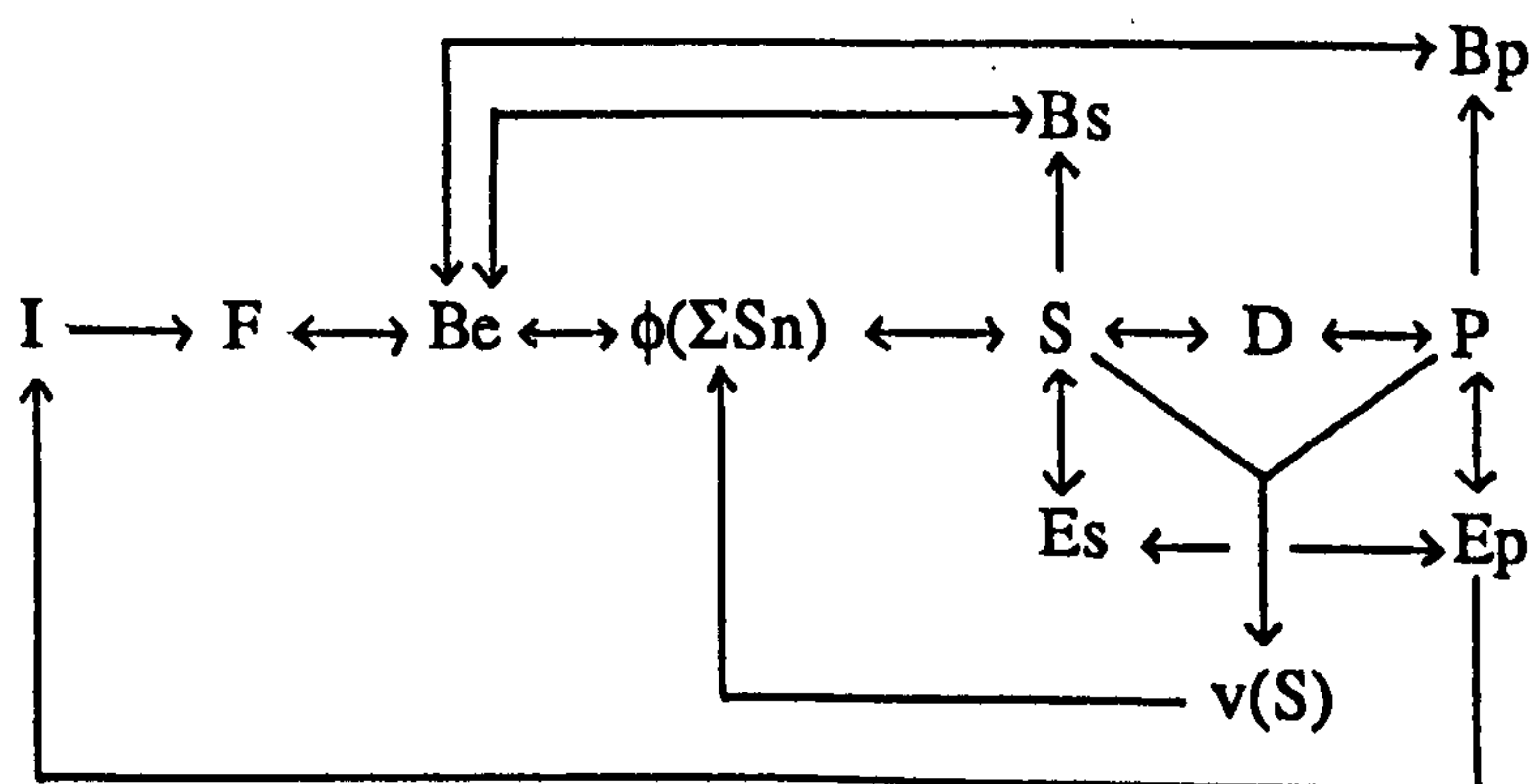


which assimilates the following paired relations (including indirect relations), (b), (in addition to those in (a) above):-

1	$Ep \rightarrow I$	Derivation of Design Brief
2	$I \rightarrow F$	Functional Specification
3	$F \rightarrow Be$	Functional Analysis
4	$(Es \leftrightarrow S) \rightarrow Bs$	Simulation
5	$(Ep \leftrightarrow P) \rightarrow Bp$	Real World Interaction
6	$Bs \leftrightarrow Be(F)$	Evaluation
7	$Bp \leftrightarrow Be(F)$	Evaluation
8	$Bs \rightarrow Be$	Reformulation
9	$Bp \rightarrow Be$	Reformulation <sup>65</sup>

Although the scheme as it stands incorporates a number of the key features of design process models, it can be regarded as over-idealised in one particularly important respect. If interpreted as an essentially linear model (albeit incorporating two nested iterative loops {F, Be, S, Bs} nested within {F, Be, S, D, P, Bp}), it gives the appearance that the process operates on a *tabula rasa*. In fact most accounts of the design process assume some existing product, pre-conception, analogue or proto-design as the primary material for the possibility of the process.<sup>66</sup> There are a number of ways in which this might be represented within the scheme, but for present purposes two additions are sufficient to capture the sense of contextual pre-location of the process. The first consists in a function  $\phi$  of a set or population of structures  $\phi(\Sigma S_n)$ , from which a particular structure can be selected or generated. The population of structures is presumed to be accumulated from formal or informal experience of structures or products. Given this, in addition it is posited that the relationship between a given structure (or product exemplar) as experienced and as added to the population of structures, may not take the form of a one-one mapping, but may be the subject of a transformation. This is represented in the scheme as the variance or modification of a structure  $v(S)$ .<sup>67</sup>

The general scheme can then be represented as follows :-



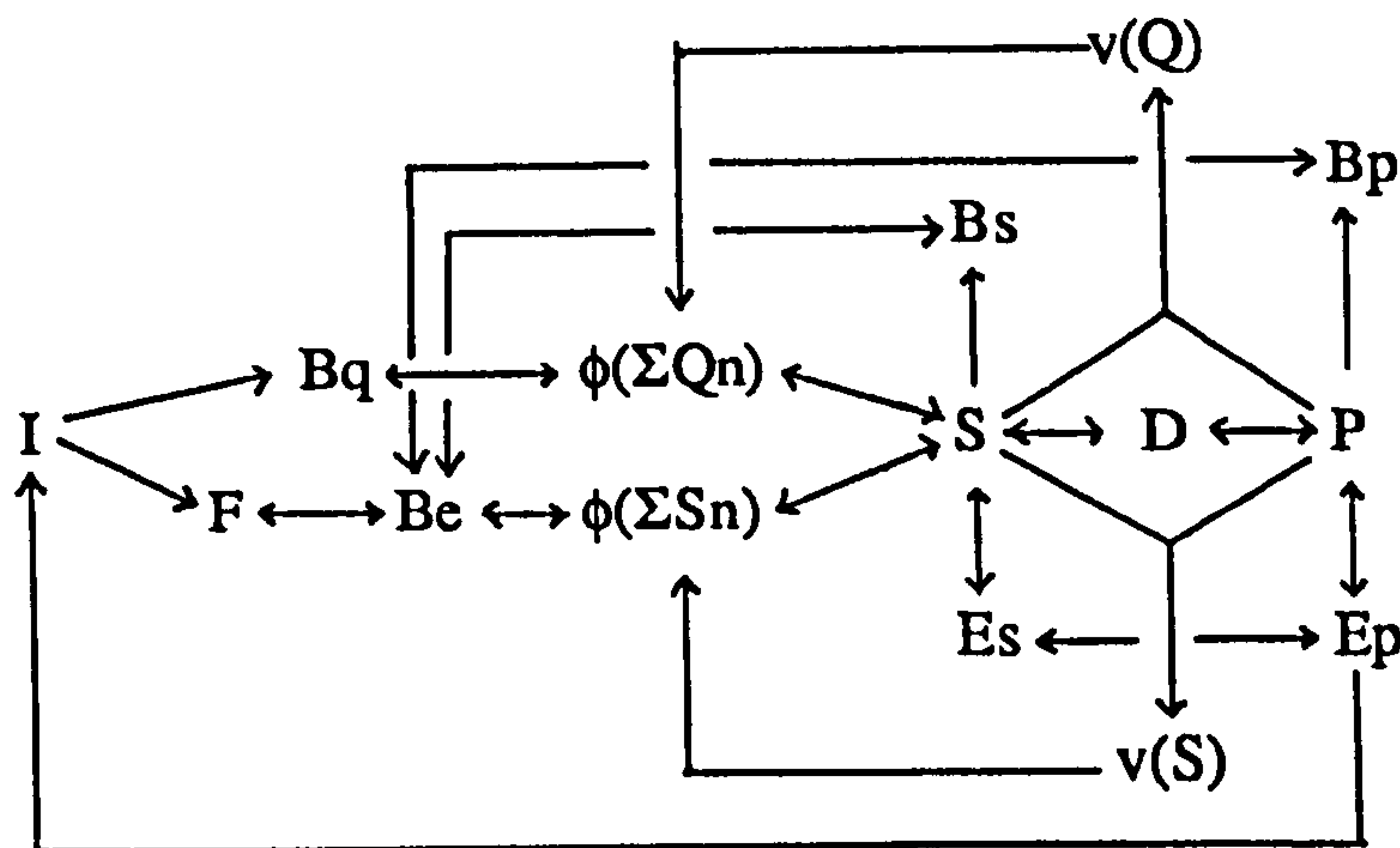
<sup>65</sup> Relations b6 and b7 are essentially comparisons between the terms which either realise F or not. If F is not realised, then the set of expected behaviours requires reformulation, respectively expressed in b8 and b9.

<sup>66</sup> Darke 1979.

<sup>67</sup> In the Hybs and Gero scheme, these features are employed as the analogues for population selection and mutation, as the basis for an evolutionary model of the design process. [Hybs and Gero 1992, pp 282-287].

### Product Semantic Methodology

The simplest and most explicit methodological implementation of product semantics is represented in the procedure developed by Butter.<sup>5</sup> This consists in a model of the design process which is isomorphic to the above scheme, but which incorporates additional loops relating to the specification of a subset of expected or desired behaviours (dispositions, properties). The form taken by this consists in two parts. The first involves the generation of semantic attributes (interpreted as attributive, qualitative or affective characterisations), which are taken to be contiguous with the general specification of expected behaviours (dispositions, properties).<sup>6</sup> The behavioural form of semantic attributes will here be represented as Bq. As with the functionally derived behaviours (Be), these will need to be implemented in the structure (S). In the case of Bq->S, as with Be->S, there is no effective procedure for accomplishing the implementation.<sup>7</sup> The transformation is achieved by trial and error and on the basis of transactional evaluation relative to experience or knowledge of the attributes of pre-existing structures or products. The loop for Bq therefore mirrors the loop for Be. The complete procedure can be represented on the process matrix as :-



<sup>5</sup> Butter 1989, 1990. Butter's scheme is the most explicit form of presentation of a general model which is common to a number of product semantic accounts. Generally these imply a meta-level relation between semantic attributes and behaviours (properties, dispositions), although the methodology is not spelled out [See for example Lannoch and Lannoch 1989; Lannoch 1990; Smets 1989; Krampen 1989; Oehlke 1990]. Smets and Overbeeke 1995, introduce a more formal approach involving multi-dimensional scaling of bi-polar attributes, pre-figuring work by a number of other researchers [see below footnote 6, and footnote 8, p 475].

<sup>6</sup> Normally in the form of a prioritised set of adjectives or adjectival constructions specifying the required expressive properties of the structure in which they are implemented. In Butter's procedure this comprises two parts - a positive model (desired qualities) and a negative model (undesired qualities) which are assimilated. The complex behavioural specification consists in a hierarchically organised sequence of conjunctions and disjunctions (eg in respect of a vehicle { rugged & - aggressive }, { (comfortable v accommodating) & - posh }). [Butter 1989]. The procedure described by Butter is presented and implemented informally, however recent work has specified more formal methods for generating and analysing semantic attributes and relating these to the application of transformation rules, in restricted design domains. See for example Hsiao and Wang 1998.

<sup>7</sup> 'Effective' in the sense, for example, of specifying an algorithm.

The operation of the procedure is restricted to the immediate design process (with the exception of the knowledge and experience brought to bear in terms of the changing sets of structures and qualities,  $\phi(\Sigma S_n)$  and  $\phi(\Sigma Q_n)$  respectively. This effectively restricts the process to the scope of the more general designation of the relevant design domain. The semantic scope is therefore highly localised.

Even in this restricted context, there are a number of significant methodological problems. In the first place qualitative characterisation (Bq) (for example in terms of adjectival constructions) operates at a meta-level with respect to properties and behaviours (Be). In addition, it is not possible to distinguish a coherent or consistently defined object language in respect of this meta-level. In addition to properties and behaviours, appearance attributes and evaluative terms are spanned by terms at the meta-level.<sup>8</sup> Given the relationship between function, behaviour and structure in the core model, it is not clear how Bq relates to Be, or to S. This is particularly the case if one considers that whilst it is possible to conceive of formal or semi-formal definitions for structure and to relate these to instantiations in a way in which the idea of a structural identity can be grasped, there is no perspicuous parallel in the case of a quality complex.

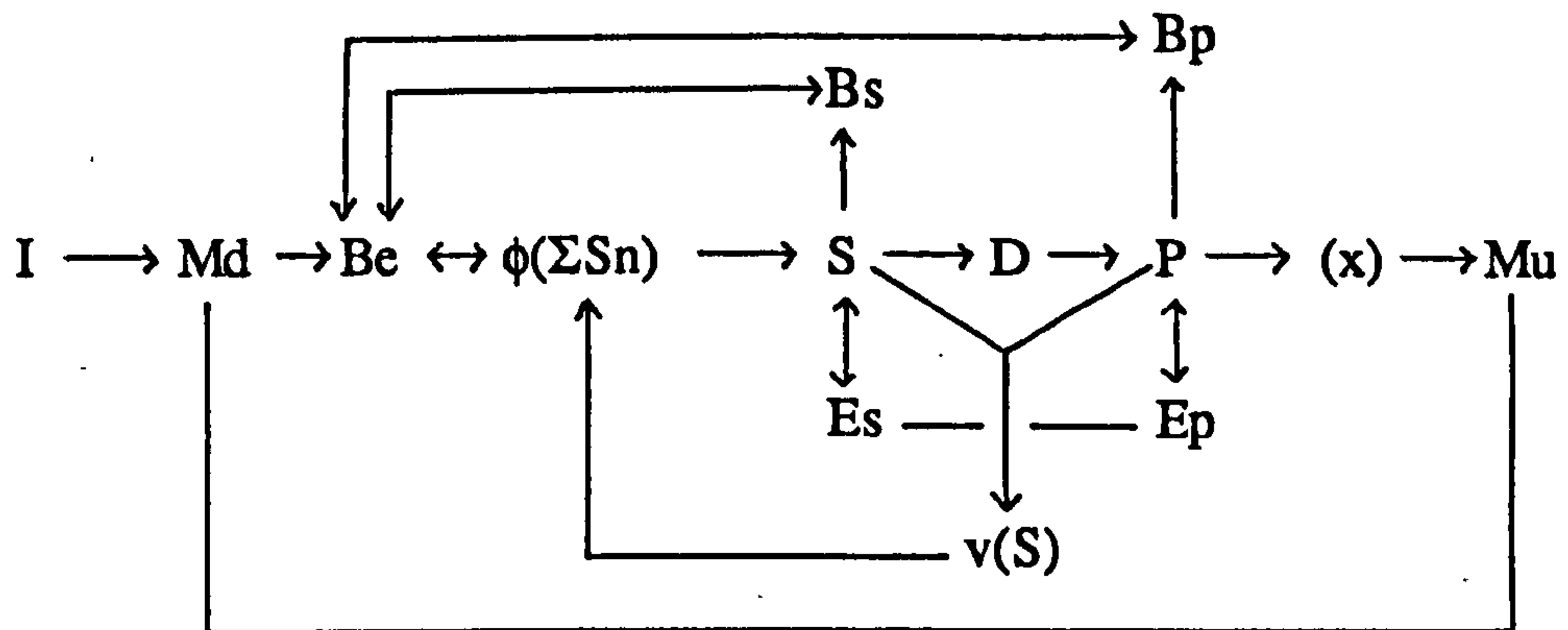
Further methodological problems arise in considering the relationship between the qualitatively specified behaviours (Bq) or quality complexes ( $\Sigma Q_n$ ), and the structure (S). These are well brought out in more formal attempts to apply semantic transformation in the case of CAD systems.<sup>9</sup>

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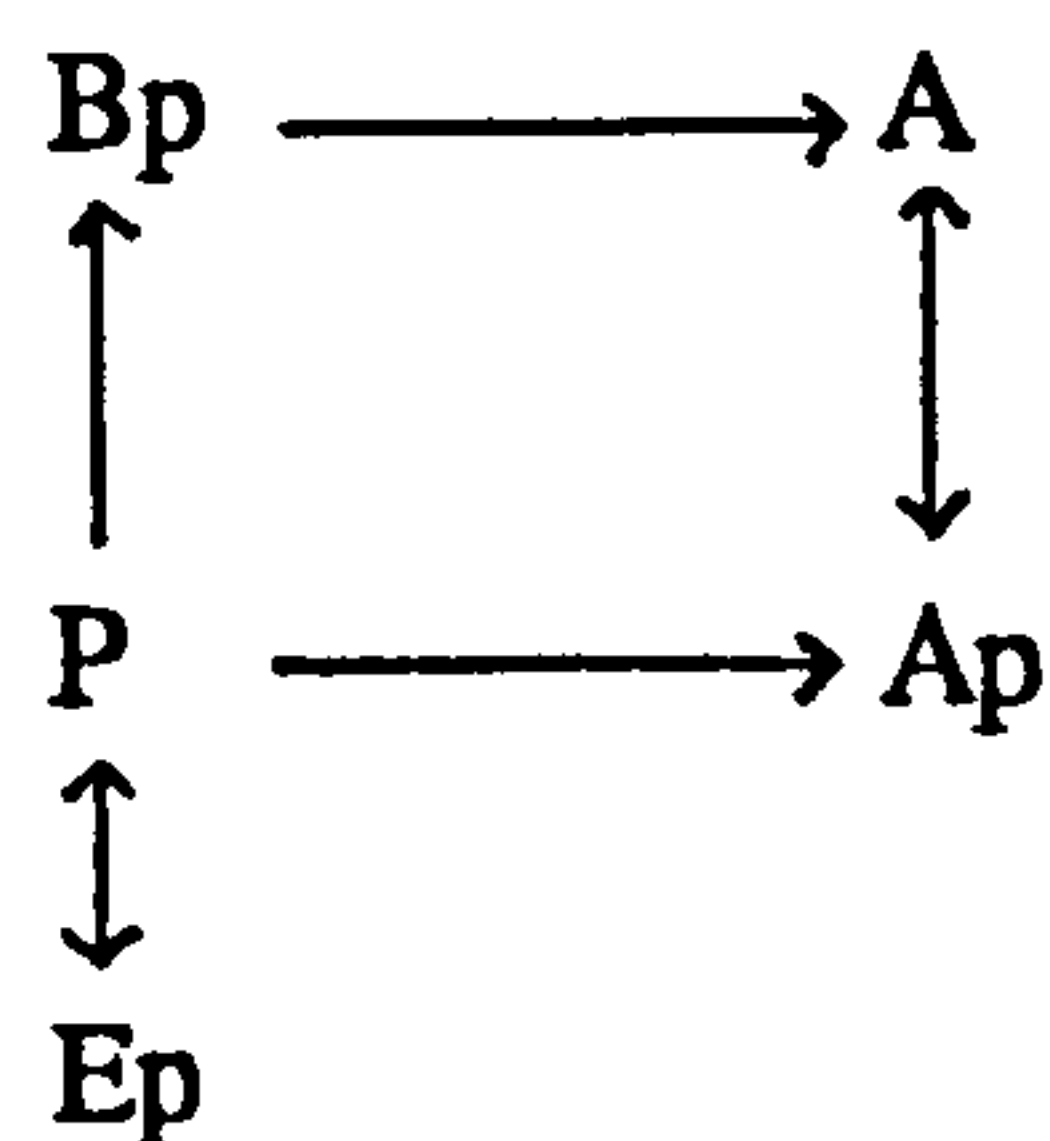
<sup>8</sup> See above Section 8.2 'Expression'. The hierarchical relational structure of 'properties', 'attributes', 'characteristics' and 'characters' and their methodological implications and possibilities have recently been explored in the insightful paper by Janlert and Stolterman 1997.

<sup>9</sup> See for example the study by Chen and Owen, who explore the possibility of a 'style description framework' for the systematic description of the qualitative content of products which can be used extrapolatively in the specification of styles for products for new target markets. The procedure consists in establishing a 'style profile' using weighted polar adjective scales applied to six categories of product content, and fine tuning the profile in terms of indices of 'importance' and 'confidence'. [Chen and Owen 1997]. The more general implementation involves establishing a number of additional related procedures, primarily concerned with establishing formal transformation rules which have generally been based on fuzzy set theory and/or shape grammars. [See for example, Hsiao 1994, Hsiao and Cheng 1996, 1997; for the development of this approach]. A general method of this type, incorporating the features of semantic transformation as style profiling and the derivation of shape regulation rules has recently been proposed. The essence of the method consists in establishing a database of product form-image word relations in terms of fuzzy sets. Multi-dimensional scaling is used to establish relations between 'perceptual space' descriptions and shape regulating rules. Shape transformations on a basic model can then be driven by an interrogative database which is also based on a fuzzy implementation [Hsiao and Wang 1998]. The principal limitations of the method lie in the need for relatively well defined product classes and the difficulty in relating holistic judgements to local judgements (even in respect of such well defined product classes).

The more radical methodological implementation stems primarily from Krippendorff.<sup>73</sup> In this case meaning M replaces function F, and M constitutes the assimilation of the users cognitive models to the design process model. Users cognitive models pre-exist the occurrent design process and are operative in terms of cumulative prior interactions with products (and objects generally). In principle then the derivation of M is in terms of the complexes represented in  $(P \leftrightarrow Ep) \rightarrow Bp$  via x (processes of transformation).

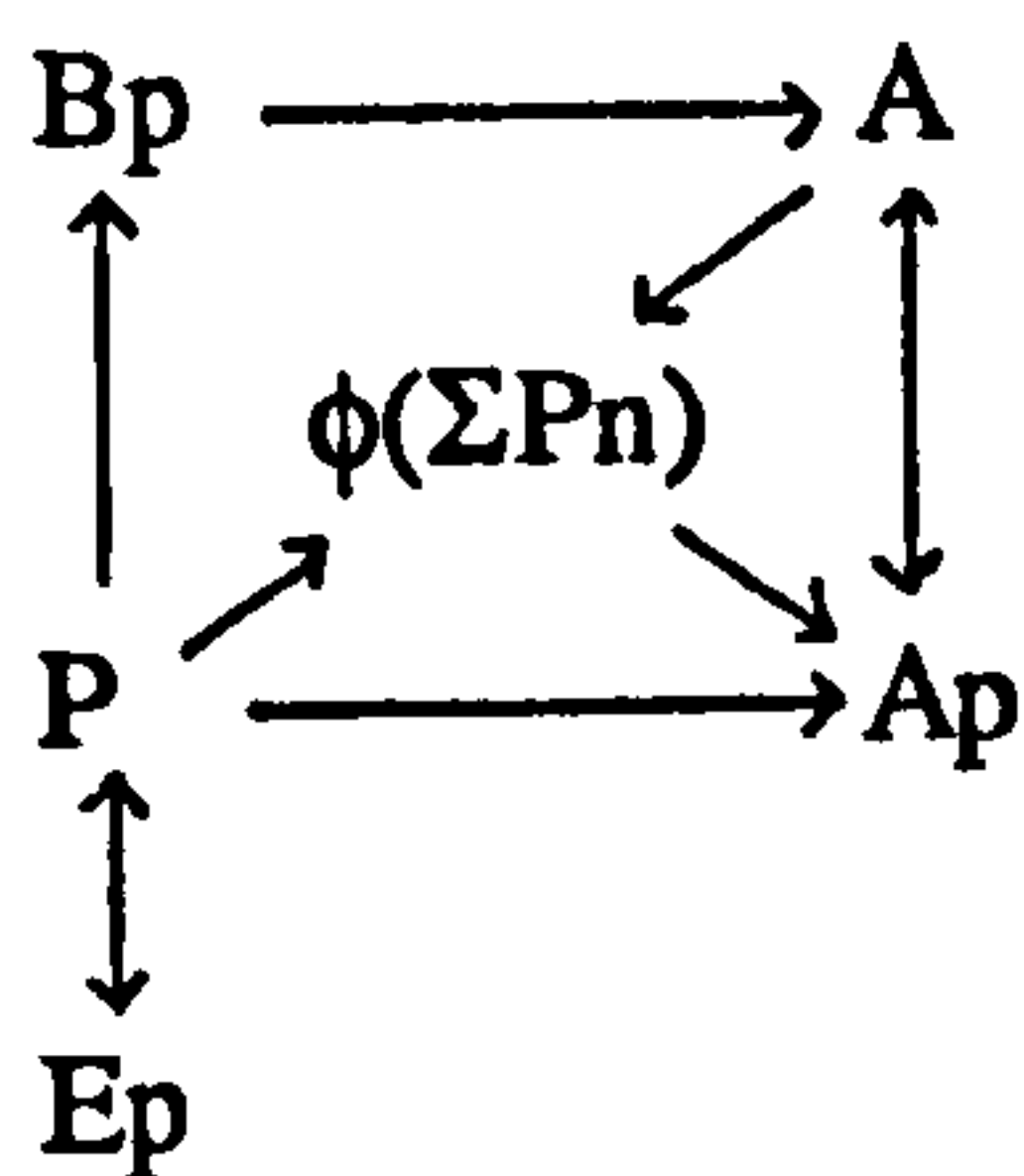


The cognitive models deployed by the user in the construction of a given M comprise a complex set of relationships with the behaviours (dispositions, properties) characterising the product P in environment or context Ep. The behaviours (properties, dispositions) Bp of the product (which derive from P in the operational environment Ep), give rise to the affordances A of the product. The perceive-affordances Ap of the product comprise a complex of relationships which together constitute the meaning of the product for the user (Mu). The simplest element of the complex consists in the direct relationship  $P \rightarrow Ap$ , which is the equivalent of the Gibsonian direct perception of affordances. The relationship between basic affordances and basic perceive affordances relative to the product in the design process model can be represented as :-

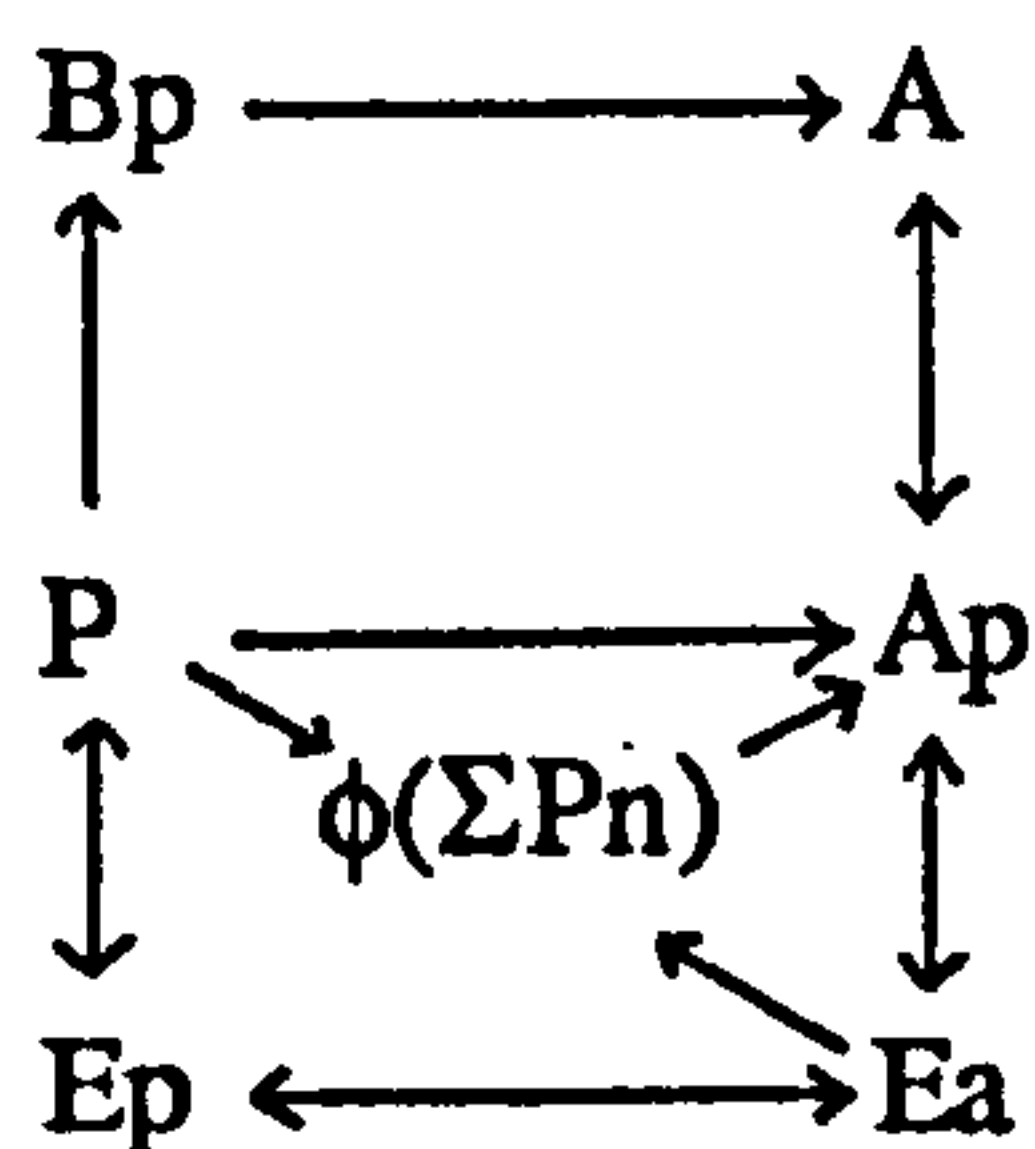


However given that the cognitive construction of meaning is conceived as conceptual and experience-based, there is also a relationship between affordance and perceive-affordance which is mediated rather than direct, which involves the assimilation of affordance and perceive-affordance encounters analytically relative to given products. This can be represented in terms of the conventions of the scheme as :-

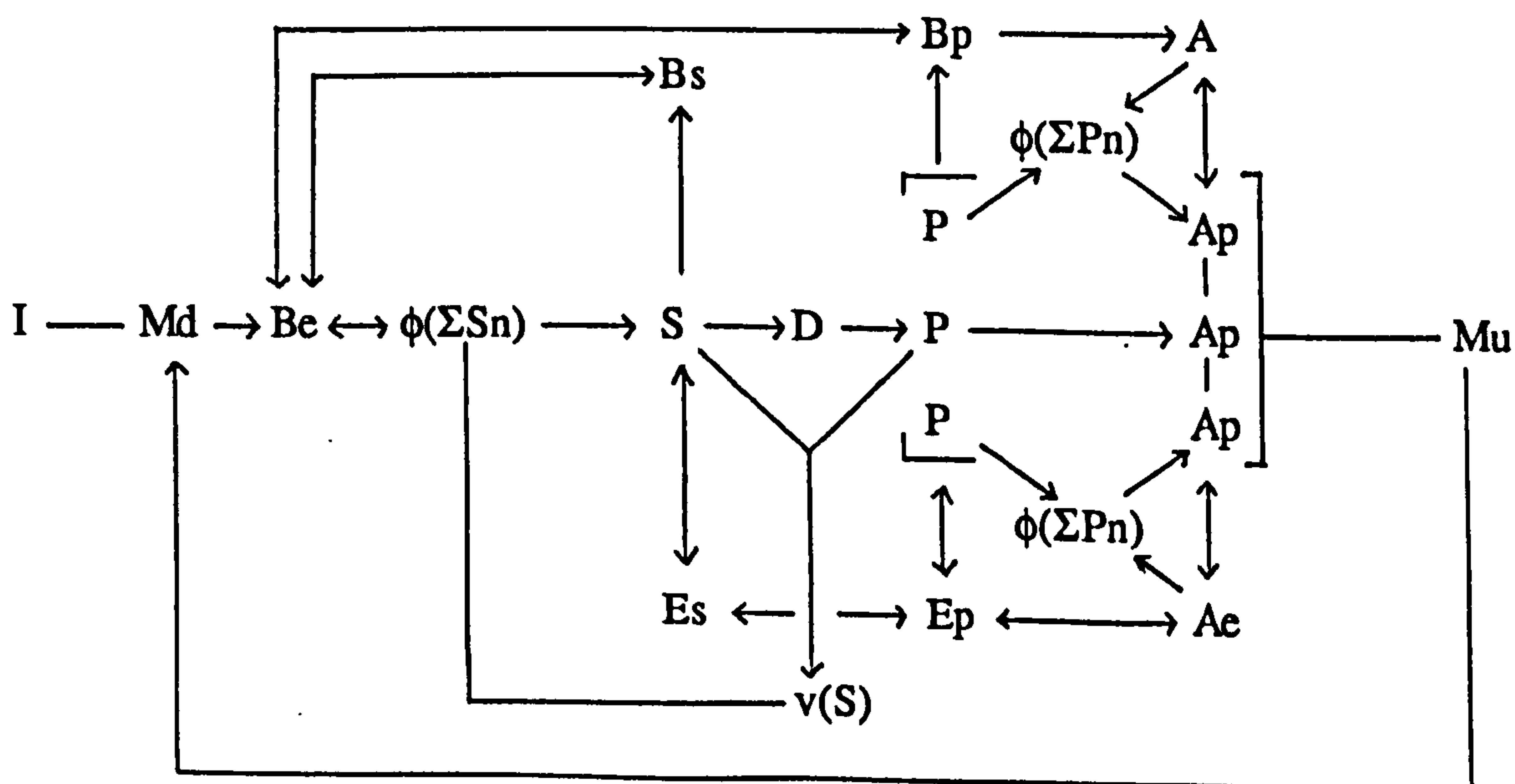
<sup>73</sup> Krippendorff 1989, 1990.



In addition the cognitive construction of meaning is taken to involve contextual factors, in the sense that perceive-affordance is dependent upon the context in which the product is experienced, which may or may not be equivalent to the context or environment in which the product can give rise to the behaviours  $B_p$  that support affordances. In order to express this a further term  $E_a$  is introduced to represent the environment or context operative relative to the context of the affordance and perceive-affordance of the user. Similarly, given the conceptual and experiential orientation of the product semantic model there is a mechanism which allows for the analytic assimilation of contextualised encounters relative to given products. These might be embodied in terms of scheme conventions as :-



Bringing these elements together in relation to the overall design process model yields:-





The cognitive construction of meaning by the user then consists primarily in the interaction between three elements of perceive-affordance. The core element comprises the direct perception of affordance.<sup>11</sup> The second element consists in the relation between affordance and perceive-affordance as mediated by a conceptual scheme, which essentially consists in the dynamics of a categorial scheme centred on the type identification of products. The third element consists in the relation between different products as distinguished by differences in context, represented in the dynamics of a categorial scheme linking contexts to affordance/perceive-affordance relations.

Krippendorff's contention is that in order to arrive at a design process which is properly sensitive to user interaction, this composite cognitive model should be built into the design process model. Thus the term Md (designer's meaning) in the scheme stands as a place marker for the projective recapitulation of the processes of user interaction. The underlying assumption is that analytic and explanatory structures are isomorphic with synthetic and predictive structures<sup>12</sup>, and that therefore some degree of compositionality is operative.<sup>13</sup> These assumptions are reflected in each of the groups of design methods proposed for the implementation of the product semantic approach.<sup>14</sup>

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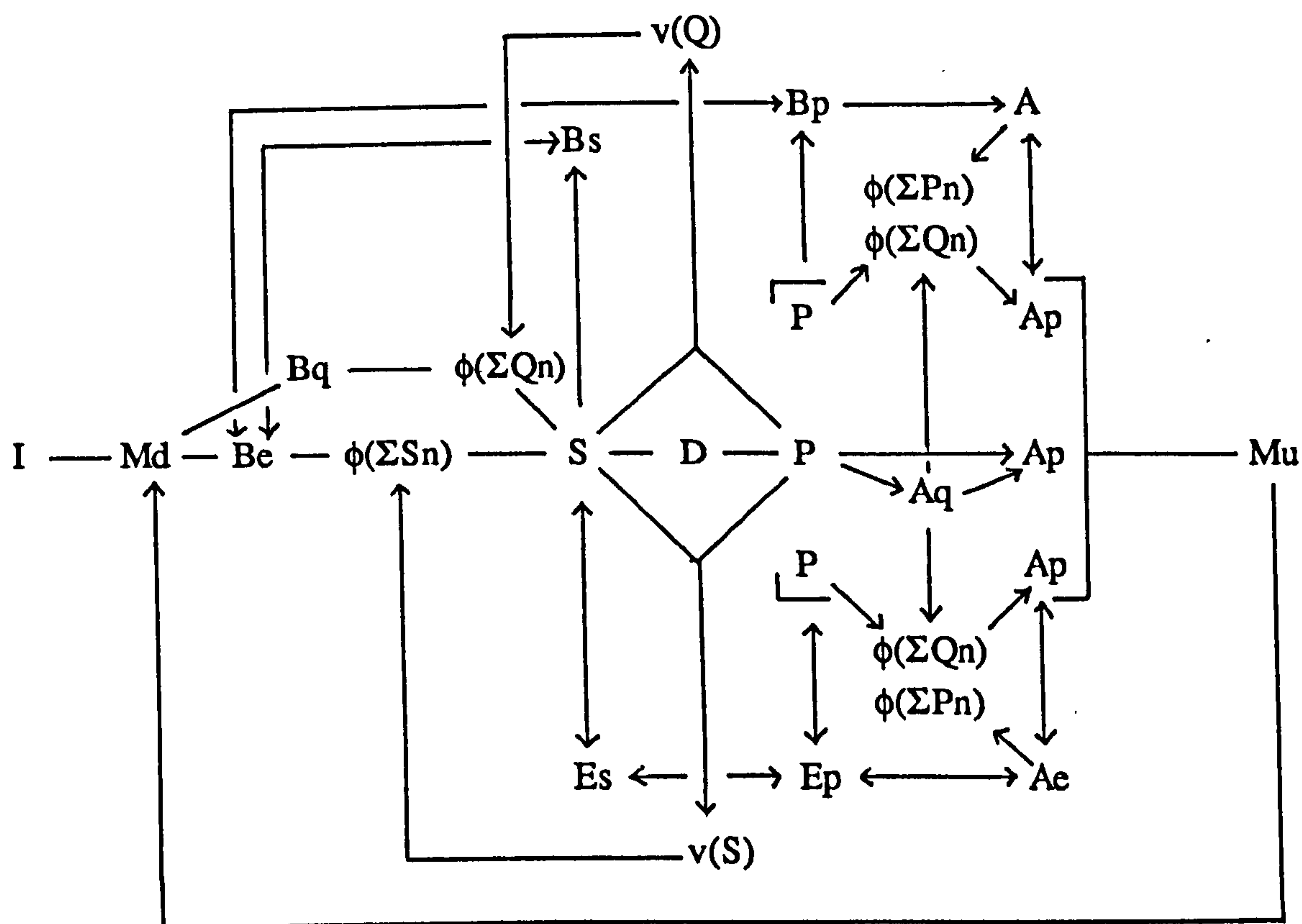
<sup>11</sup> In the Gibsonian scheme this is the single element of affordance, which remains unmediated at the conscious level, even though the terms of engagement become increasingly complex as the environment constituting the context for affordance acquires socio-cultural layers. Whereas Gibson's move is essentially the assimilation of culture to nature, in Krippendorff's scheme the idea of basic affordance plays a subsidiary role to the idea of affordance as cognitively mediated - nature is assimilated to culture. Nevertheless Krippendorff does acknowledge the existence of basic affordance as one among a complex group of object relations. Krippendorff 1989, pp16-20 and passim.

<sup>12</sup> This positivist assumption runs counter to the general thrust of Krippendorff's anti-positivist line. The assumption is in any case unwarranted given the arguments against the isomorphism of prediction and explanation, even in cases where a deductive nomological model is accepted.

<sup>13</sup> Given the role of the proposed design methods outlined by Krippendorff, the sense of compositionality implied is strong. This is the case because of the assumption that it is possible to generalise over operational procedures, across contexts and in divergent product domains, in terms of cognitive models. The problem here is that in adverting to the idea of a small number underlying cognitive mechanisms which support a wide range of different activities, Krippendorff does not allow for the possibility of intrinsic differences in outcome for the same mechanism relative to context, and therefore assumes a combinatorial strategy in accounting for complexity. In one sense this is the conceptual equivalent of not taking the environment into account in positing perceptual and cognitive models, and building too much structure into the models as a result.

<sup>14</sup> See above pp 36-37. Krippendorff proposes three classes of design method - Descriptive, Anticipatory and Creative. Descriptive methods underlie the other two classes, and consist in the systematic appreciation of user practices in terms of the relationship between operational competence and understanding, and higher levels of symbolisation (including normative factors). Anticipatory methods deploy these results projectively in the prediction of the 'meanings' of proposed products. Descriptive and Anticipatory methods are mediated by Creative methods which are intended to define the relationship between a) semantic attributes and product content, b) the ethnographics of practices and product affordances, c) linguistic descriptions and form. Krippendorff explicitly rejects the idea that it is possible to compile a formal vocabulary, but assumes that the methods are compositional at the level of deployment of cognitive models.

An intermediate implementation is represented in Vihma's analysis.<sup>15</sup> The analysis is congruent with the methodological implementation derived from Butter in the sense that a qualitative element is taken to inform the derivation of structure (S) in the design process. It is also congruent with the methodological implementation derived from Krippendorff in the basic structure of product encounter in the construction of meaning, in terms of contextually relativised affordance/perceive-affordance interactions. Vihma also draws attention to the qualitative content of product encounters, which are primarily embedded in iconic signification associated with the realisation of affordance/perceive-affordance interactions. In addition, a basic qualitative element is taken to form part of the direct perception of affordance. These elements might be represented in the matrix as :-



<sup>15</sup> Vihma 1995. Since this analysis approaches the question from a semiotic standpoint, the terminology is orthogonal to that used by Krippendorff and Butter. In relation to the design process matrix, it is clear that Vihma equates the semiotic dimensions 'syntactic' and 'material' with the content of the configurational variable S in the matrix. It is also clear that the 'pragmatic' dimension corresponds to the complex constituting the user interaction with the product. It is less easy to assign an unequivocal role to the 'semantic' dimension which spans elements of identity (type identity and contextual identity) and affordances. In addition it is not clear to what extent the semantic dimension is intended to encompass the qualitative experiential content of user interaction, since this is partially assigned to an aspect of interaction, 'aesthetics' which is not represented as a semantic dimension. However, if the account is regarded as orthogonal in the sense suggested in the introductory section pp 58-63, then given Vihma's interpretation of semantics in terms of forms of signification derived from Peirce's scheme (Iconic, Indexical, Symbolic), these can be assigned the roles of being the different means by which affordance, perceive-affordance, quality attribution and identity are collectively achieved.

The principal difference in Vihma's analysis is that it is not suggested that Mu (or the processes that comprise the construction of Mu) can be built into the design process. Although it is possible to analyse the content of a given construction of Mu in terms of values for the components, it is not assumed that the process is hierarchically compositional.<sup>16</sup> This means that in practice (in the context of synthesis as opposed to analysis) the implementation of methods approximates to Butter's procedure.

### *Overview*

The most striking aspect in taking a methodological perspective, is the narrowness and simplicity of the range of methods actually deployed, when these are set against the complexity implied by the conceptual commitments made. The more so if one considers the methodological desiderata initially identified in the construction of the framework, which are then not taken up and addressed.<sup>17</sup> In practice there are two principal methodological strategies that are deployed - the use of a semantic differential method based on attributive terms to capture product character, and the use of the categorisation scheme to model product positioning.<sup>18</sup>

Although the methodological implementation of the product semantic approach is (so far) narrowly restricted, the methods that have been implemented have a number of features in common. Generally they are semantically holistic, and access semantic value via the application of attributive terms. The assumption in these approaches is that a sufficient grip on implied product content can be gained in a two stage process in which semantic value defined in terms of the quality of preferred user interaction is accessed by the selection and ordering of attributive terms, and where ordered values can be translated into implied formal content. Verification of the latter is accomplished by feeding these results back into the process of applying and ordering attributive terms. These processes are applied with varying degrees of formality.<sup>19</sup>

The general problem is that the product semantic account does not derive an analysis of linguistic attribution in parallel with its account of meaning, and therefore has no theoretical basis for framing an empirical hypothesis about the relationship between the

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<sup>16</sup> This is consonant with the general position derived from a semiotic approach, in which syntactic and semantic elements are taken to develop together, and are mutually defining. This is also the case in terms of the idea of signification unpacked in the form of 'fields' and 'exemplification'. See above pp 242-246.

<sup>17</sup> Interactive operational cognitive models and ethnographic analysis for example. [See Section 2, *passim*]

<sup>18</sup> In the application of product semantics in design practice, the predominant additional strategy consists in what Krippendorff refers to as 'layered semantics'. This essentially consists in defining hierarchies in levels of intervention, and defining an operational pattern appropriate to that level, and the conditions under which the next level is accessed.

<sup>19</sup> See above pp 474-475 and footnotes.

linguistic expression of the components of signification and meaning, and formal content. This is particularly the case where no clear distinction is made between attribute types.

Although this has to some extent been addressed more recently in the application of multi-dimensional scaling techniques to define semantic quality spaces within restricted product domains, the problem here is akin to the application of overall similarity measures in numerical taxonomy in the absence of an underlying theory (such as an evolutionary theory), where it is difficult if not impossible to generalise across domains, or to draw significant inferences from the semantic parsings that emerge.<sup>20</sup>

In the case of the application of the product semantic categorisation model, although there is no reason to doubt that it does model aspects of meaning relations, what it describes are relations at the level of Krippendorff's context of ecology, and there is little in the model to support the idea that it does this by representing the general form of a cognitive process. Although it is likely that aspects of the process of categorisation map to a prototype-semantic implementation, empirical studies suggest a more complex picture.<sup>21</sup>

Although attributive or categorial modelling may be useful pragmatic tools for partitioning the higher order property or quality spaces occupied by products, it is unlikely that they function in the way that the product semantic account suggests. The thrust of that account is that adequate user modelling depends on characterising the cognitive processes involved in the construction of meaning, but the methods that are actually implemented are disengaged from the conceptual commitment of the framework. This is the case because the components of the methodology (synthetic elements of the design process) which are conceived holistically, on the basis that meaning is apprehended holistically, do not map convincingly to the analytic structure of the semantic concepts constituting the framework.

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<sup>20</sup> See above pp 474-475 and footnotes.

<sup>21</sup> See Section 5 'Categorisation' above.

## Appendix E Belief and Acceptance

The structure of practical reasoning and situated judgement is distinctive not only in its modality,<sup>1</sup> but also in its relation to concepts such as intention and belief. The basis of practical reasoning and action is commonly taken to be that we seek to realise our intentions and satisfy our desires in the light of what we believe. Such activity takes place in the context of finite resources and the need for social and intra-personal co-ordination, and typically involves prior plans and intentions. The primary factors which are perceived to structure practical reasoning relate to the implicit demands for coherence and consistency in such reasoning. Plans involve the need for coherence both in respect of their systematic relationship to our beliefs, and in the light of their typical partiality, to the constraint for continuing coherence as they are filled out and developed.<sup>2</sup> In addition they need to be both internally consistent and consistent with our beliefs.

Typically this generates a three-stage model of practical reasoning. Firstly, prior partial plans generate problems relating to the need for coherence between elements. Secondly, attempts are made to identify options that would both solve, or partially solve, the problems posed and meet consistency criteria. Thirdly, deliberation aims at making a choice between the available options. Whilst most reasoning models and traditional decision theory are concerned with the final deliberative stage, which is modelled in propositional and logical terms, the nature of practical reasoning can only be captured by giving equal attention to the framing of deliberations represented in the earlier stages.

The critical question relates to the nature of the background knowledge and assumptions that are tacitly employed in framing deliberations.<sup>3</sup> All deliberation and decision making involves such features and these are normally considered to be represented in the beliefs of agents, whether these are expressed determinately or probabilistically.<sup>4</sup> However there appears to be a clear distinction between the key features of 'belief' and the characteristics

<sup>1</sup> See above, Section 10.4 Experiential Content, 'Reasoning and Judgement' pp 348-350.

<sup>2</sup> Bratman has termed this constraint on practical reasoning as 'means-end coherence'. [Bratman 1987, 1990, 1992].

<sup>3</sup> The 'tacit knowledge and assumptions' referred to here do not have the specialised sense given to them by Polanyi [Polanyi 1966], or in a design context by Abel [Abel 1981], but rather the more general sense of being unstated but assumed in reasoning. In formal terms they are the equivalent of enthymemes or suppressed premisses in logic. There is nonetheless an important sense in which the general and specialised senses are related in the necessity for a whole range of assumptions, and their being implicitly shared, for any successful intersubjective process of reasoning and action to take place. The discipline centred basis of such frameworks are discussed by Hirst [Hirst 1975] in the context of education.

<sup>4</sup> In Bayesian decision theory, for example, degrees of confidence represented by subjective probabilities are taken to be basic, with all-or-none beliefs as the limiting case. In contrast some theorists assume that the all-or-none case is fundamental. [Harman 1986]. The value of holding either as basic, or reducing one to the other is not apparent, as they appear to have distinct central functions in cognition. There does seem to be a clear distinction between the kinds of thing that are naturally subject to all-or-none characterisation, such as the belief that it is Christmas day tomorrow, and graded expectations such as the belief that it will rain tomorrow.

of the tacit elements in decision making, and these may be expressed in terms of the contention that our ordinary conception of belief involves a number of inter-related features that are not necessarily shared by the background assumptions made in framing deliberations.<sup>5</sup> These are firstly, that reasonable belief is context independent. Secondly, that reasonable belief is shaped by evidence for what is believed and concern for the truth of what is believed. Thirdly, that belief is not normally subject to voluntary control. Fourthly, that an agent's beliefs are subject to demands for consistency and coherence.<sup>6</sup>

The principal distinction between 'beliefs' and 'background assumptions' in practical reasoning, from which the remaining distinctions flow, lies in the degree to which these two distinct concepts can be held to be context dependent or independent. Reasonable belief is generally held to be context independent in the sense that at a given time a reasonable agent either believes something (to some degree) or not.<sup>7</sup> In contrast the various practical reasons for accepting or assuming propositions forming the background for deliberations can be seen to be context-relative and therefore distinct from belief, and also distinct from other forms of assumption such as supposition or pretence.<sup>8</sup> The forms taken by such context-relative acceptance include 'economy', 'error asymmetry', 'social pressure', 'personal relations' and 'pre-conditions'.<sup>9</sup>

Economy of reasoning involves strategies which include context-relative acceptance.<sup>10</sup> This typically takes the form of situations in which one acts in everyday contexts, for example on the basis that the status quo will be maintained, although in the face of differently contextualised questions, one might not take this for granted, but rather draw in a wider set of assumptions changing the level of complexity and the basis of the reasoning involved.<sup>11</sup>

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<sup>5</sup> Cohen 1989.

<sup>6</sup> Bratman 1992, pp 2-4. The outline of the distinctions between belief and background acceptance in the first part of this section is substantially based on Bratman's paper.

<sup>7</sup> There are of course questions relating to quasi-context-relativity, which depend on ambiguities arising from the deployment of referring or designating expressions, for example the spatio-temporal relativity of a claim by me that 'Henry believes that the car was here', but these are context relative only in relation to the specification of reference and not in what is held by the believer. Apparent context relativity will also arise in respect of the particular forms of expression of belief to which assent might be given by an agent. Bratman cites Perry's example that if I ask Sue whether the meeting is at noon she may say yes; if I ask whether the meeting is now she may say no; and yet it is now noon. In order to meet Perry's resulting distinction between 'belief states' and 'what an agent thereby believes', it is necessary to specify that the context independence of belief is relative to a proposition and an agreed associated belief state.

<sup>8</sup> Stalnaker 1984, pp 80-81; Bratman 1996, p 4.

<sup>9</sup> Reviewed in Bratman 1996, pp 5-8.

<sup>10</sup> Harman 1986.

<sup>11</sup> Generally I simplify my reasoning relative to planning my work, accepting that the general context and time scale of the job remains roughly constant. In the context of specific questions or considerations I will modify the background of acceptance, allowing for change in both context and time scale.

Error asymmetry is an inherently context-relative aspect of practical reasoning which, in contrast to economy of reasoning, may involve accepting something which one does not believe. This typically takes the form of making assumptions that will minimise, maximise or optimise costs, risks and outcomes, and which will vary with context. In an engineering problem, for example, I may in one context accept a high loading factor on the basis of a cost/risk analysis allowing for uncertainty, which I do not believe reflects a realistic loading, and which in another context where the cost/risk balance is lower, I would reject.<sup>12</sup> The types of context relativity in the case of individuals, outlined above, are also evident in background acceptance in situations of social co-operation and social pressure.<sup>13</sup> In addition there are cases of acceptance grounded in special relationships to friends or family,<sup>14</sup> and pre-conditions which are assumed in the background of almost any planning - such as the possession of free will or being alive.

The thrust of such arguments is that there is an important element of practical reasoning which involves context-relative acceptance, which is distinct from belief in each of the key respects in which reasonable belief is characterised. Acceptance can reasonably vary across contexts; can be affected by practical considerations which are not tied to the truth of what is accepted; can be voluntarily accepted; is not subject to the ideal of cross-contextual coherence and consistency constraints.<sup>15</sup> Given that background acceptance has these features that distinguish it from belief, the question arises as to the nature of its relationship to reason and action. One possibility is that context-relative acceptance is in some sense equivalent to supposition, but although making a supposition can invoke conditional planning and extrapolation, it cannot generally direct action.<sup>16</sup> A further possibility suggested by the characteristics possessed by acceptance is that it is related to pretence. Although there is a clear correlation in behavioural terms, in that accepting that *p* is the case may involve behaving as though one thinks that *p* is the case, acceptance appears to have a further implication relating to reasoning, that is not present in the case of pretence. Accepting that *p* is the case additionally involves reasoning on the assumption that *p* is the case.

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<sup>12</sup> Bratman considers a range of examples of this kind which draw in a number of such contextual factors which are essentially based on variations in the notion of differential costs of errors. [Bratman 1992, pp 6-7].

<sup>13</sup> Stalnaker 1974.

<sup>14</sup> The example suggested by Michael Dummett and recorded by Bratman [Bratman 1996, p 8].

<sup>15</sup> There is no in principle reason to suppose that context independent cognitive attitudes cannot ultimately be explained in terms of context dependent cognitive attitudes. On the other hand neither does this in-principle reduction diminish the importance of context relative acceptance, although it does raise questions regarding its conceptual status.

<sup>16</sup> I can suppose that I had won the lottery and contingently plan the purchase of a Georgian Mansion in Hampshire, but the supposition will not support the purchase.

It may be argued that there is no significant distinction between the relationship of context dependent acceptance to practical reason, and that of degrees of confidence in relation to theoretical reason, and that ultimately there is a single framework for theoretical inquiry and for practical deliberation which is founded on the concept of belief, and which is locally modified to meet the needs of particular contexts.<sup>17</sup> The extrapolation of this argument is that the belief systems of agents constitute the default cognitive background for deliberation and planning. As such it will have the general characteristics of beliefs, and in particular, context independence. Background acceptance consists in positing a proposition that is not believed, or withholding the use of a proposition that is believed, and thus making a context relative adjustment to the default cognitive background.<sup>18</sup>

Acceptance then may be a context relative adjustment to a context independent belief framework, behaviourally related to pretence, though having additional implications relating to reasoning, and ratiocinatively related to supposition though holding additional behavioural or action related implications. This comparative relationship between acceptance, supposition and pretence suggests that they may form a graded or hierarchical ordering of concepts (with others) linking the cognitive and behavioural components of reasoning and action, and related to belief and intention.

The fundamental distinction partitioning groups of concepts characterising cognitive attitude relates to context dependency. Reasonable belief is context independent, as is intention. Acceptance and its cognates are context dependent, as are decisions. In propositionally driven models, the basic form is taken to be the content of psychological attitudes such as belief in the context of a planning model. In non-propositional models context-dependent de facto acceptance in the context of a simulation model would be regarded as basic, with attitudes such as belief constituting the highest level of cross-contextual normative abstraction.

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<sup>17</sup> Levi 1980.

<sup>18</sup> Bratman argues contra Levi, that the distinction between acceptance and degrees of confidence relative to belief is a substantive one, but in proposing the default cognitive background model, acknowledges the stability of a framework of belief, against which acceptance constitutes an adjustment. Nevertheless he does demonstrate that '...there can be reasonable differences between one's adjusted cognitive background for a given practical context and one's context-independent, default cognitive background. So the explanation of decision and action will in general need to appeal to a cognitive attitude that neither itself guarantees nor is guaranteed by corresponding belief.' [Bratman 1992, pp 10-11].



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