Object Individuation and Identity in Cognition [*]

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Abstract

This paper deals with a dispute between two positions concerning the nature of singular thinking: the Relational View and Sortalism. After reviewing some experimental work on the visual representation of medium-sized objects, I argue that Sortalism cannot account for the data.

1 Introduction

1.1 Singularism and Descriptivism

Quine (1956) once illustrated that the desire to have a specific boat – Nautilus, let's say – and the desire to have, as he put it, mere relief from boatlessness invoke quite different courses of action. In the first case, the desire would be satisfied just in case a specific boat is obtained, so a quest to find Nautilus would have to be undertaken. In the second, any boat would do. One would have only to go to the local harbour. The difference in behavioural patterns allegedly reflects the different kinds of propositions that serve as objects of the agent's desires. In the first case, the proposition is singular (*de re*), whereas in the second, the proposition is general (*de dicto*). Despite the robust agreement on drawing this distinction, there is great controversy when it comes to how it should be spelled out in theoretical terms. Intuitively, if an agent has an attitude (belief, desire) towards a singular proposition, she must be able to single out a specific object (e.g. Nautilus) in her mind. Conversely, if an agent has an attitude towards a general proposition, no particular object has to be mentally singled out; only a relevant kind needs to be identifiable (e.g. boats). Thus, it is claimed that singular propositions are

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individuated, at least partially, by the objects they are about[1], whereas general propositions have only concepts as their building blocks.

When it comes to the individuation of specific objects - the constituents of singular propositions - a discussion between two schools of thought emerges. *Bare Singularism* holds that singular propositions can be only so characterized if bare objects are somehow given to us. Conversely, *Descriptive Singularism* holds that the objects singular propositions are about can only be individuated as *instantiators* of clusters of concepts, or features detected by the visual system. I am using 'features' to characterize information that is delivered visually, but might be more fine-grained than concepts. For example, one's ability to distinguish shades of red may not necessarily require the agent to have a specific RED concept for each shade[2]. For short, I will refer to the former as *Singularism* and to the latter as *Descriptivism*, but it must be kept in mind that the dispute concerns the characterization of *singular propositions*[3]. Since the notion of proposition lies at the epicentre of the language/thought interface, some clarification of its role in these two distinct domains must be made.

Singularism and Descriptivism can both be held with regard to both the domains of language and thinking, broadly understood. Singularism about language says that certain expression types, such as proper names, indexicals and demonstratives, encode instructions telling that a *specific* referent (*modulo* other grammatical constraints, such as number and gender) should be supplied as a semantic value, as suggested by the notions of *rigidity de jure* (Kripke, 1972), *REF* (Recanati, 1993), and Borg's (2004) isomorphism between linguistic referentiality and concept singularity. Descriptivism about language holds that a specific referent is not required as the expression's semantic value and thus the meanings of the demonstrative 'that' and the description 'the salient object' can be regarded as equivalent, roughly speaking. Now, Singularism and Descriptivism about language runs in parallel with, yet must be distinguished from, what I call here Singularism and Descriptivism about *mental states*. The word 'mental state' is intended to range both over states that are syntactically structured as well as states that are not. The

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[1] I say partially because singular propositions might involve extra criteria of individuation, such as Fregean senses or modes of presentation.

[2] As with all contrastive notions, defining nonconceptual content depends on what conceptual content is taken to be. Instead of addressing this issue directly, I just take the *possibility* of featural information being nonconceptual at face value.

[3] Bare Singularists usually claim that the move Descriptive Singularists make collapses the distinction between singular and general propositions. In reply, Descriptive Singularists claim that the distinction could be preserved if a referential interpretation of the object plus the properties that it instantiates is given at some point. I retake this line of argument in section 5.

latter type might include complex mental states of creatures that do not have a conceptual apparatus or a combinatory ability comparable to that of adult humans, but also temporally earlier states in mental processing that causally bring about later, cognitively richer, states. This latter subtype will be important for delineating an incremental notion of object representation (see section 4.2). Singularism about mental states holds that an object can be cognitively available to the thinker without any mention of its properties, whereas Descriptivism about mental states makes the converse claim: objects are only available to cognition as instances of certain properties, be they concepts or features.

From now on, I will engage with the debate between Singularism and Descriptivism at the level of mental states that are not syntactically structured, and thus, in what follows, the words 'Singularism' and 'Descriptivism' are intended to be understood as applying to this restricted notion of mental state. This carries interesting consequences. Firstly, I take 'individuation' as meaning 'cognitive individuation': something that agents do or something that is done to agents given their cognitive architecture (see Lowe (2007) for discussion about an alternative notion of metaphysical individuation). Secondly, as thoughts conveyed by sentences in natural language could blur the distinction between arguments made at the level of language and at level of mental states, I will restrict myself to issues arising at the level of mental states only[4]. Finally, instead of addressing the dispute between Singularism and Descriptivism about mental states directly, I will rather engage in the dispute between two theses that respectively support these positions, namely, the Relational View and Sortalism.

1.2 The Relational View and Sortalism

Russell (1910) once contrasted two ways in which one can know an object: by being directly acquainted to it (knowledge by acquaintance) or by knowing certain descriptions that the object happens to uniquely satisfy (knowledge by description). Clearly, the latter mode would require a conceptual apparatus, but it is mysterious what sort of thing a direct mode of acquaintance would consist in. In order to answer this worry, Russell held that acquaintance can be defined in terms of a cognitive relation *R* between a subject *s* and an object *o*, such that establishing the relation would be sufficient for individuating the object *o* which the mental states of subject *s* are about. Examples of *R* include: relations between agents and distal

[4] It is important to note that the target is not *Conceptualism per se*. One can be both a Singularist and a Conceptualist by proposing object-dependent concepts, which in turn would (i) be individuated without appeal to any other concept, and (ii) would not determine their referents via their properties. The notion of *de re* sense or mode of presentation is very much in this spirit (see Evans (1982); McDowell (1984); and footnote 1).

objects and the relation between an agent and her own mental states. It must be noted that *R* must be anchored in bare objects, otherwise the mode of knowledge is descriptive (see footnotes 1, 3 and 4). In this way, Singularism is supported by a *Relational View* of perceptual experience (the case that I will be dealing with here).

Descriptivism, on the other hand, has usually been associated with the anti-thesis of the Relational View. Although perceptual relations fundamentally put us *en rapport* with the environment, they are by no means sufficient according to the descriptivist. Consider someone looking at a river. The mere experience of gazing at its waters is not sufficient to cause a singular thought to arise in the subject's mind, because the relation does not determine which object the subject is thinking about. The experience *per se* would be of an ever-changing mass of water molecules. However, as soon as the concept RIVER is added to the subject's cognitive repertoire, we can attribute to her thoughts about the particular river she is looking at, say, the Amazon, despite the fact that the water that composes the river is in constant flux. For this reason, the concept WATER would not do the job and a division of labour between sortal concepts, such RIVER, DOG, CHAIR and non-sortal concepts like WATER and RED is called for. Sortal concepts then would be a necessary mechanism for 'singling out' the specific objects that we have experiences of. In this way Descriptivism is supported by Sortalism, which in turn is a particular kind of *Conceptualism* (see footnotes 1 and 3). In short, the two contrasting positions can be stated as follows:

Relational View: The specification of a suitable cognitive relation between an agent and a specific object is *sufficient* for determining which object the mental state is about.

Sortalism: The involvement of sortal concepts is *necessary* for determining which object the mental state is about.

It is important to note once again that the dispute between these two positions is about the sufficient and necessary conditions on *object dependence* of mental representations. Object dependence roughly means that the individuation and identity of the mental states depends on the individuation and identity of the objects they are about. The notions of *individuation* and *identity* will be clarified shortly. Now, object dependence itself might be a *necessary* step in the characterization of singular thoughts *proper*. Extra conditions might include combinatorial properties that human thinking display, for example Evans' (1982, 100-5) *Generality Constraint.*

1.3 The Plan Ahead

The definitions above, as they stand, suggest that Sortalism is a weaker position, since it must appeal to causal relations in order to fully characterize instances of singular thinking. If so, Sortalism must earn its keep; it must establish that the direct access postulated by the Relational View, however it might be construed, does not sufficiently capture object dependence. For this reason, I shall introduce conceptual arguments and motivations for Sortalism in section 2. Also, I shall suggest empirically-based construals of direct acquaintance and Sortalism. Both emerge out of two areas of discussion: one concerning the mechanisms of early and medium visual processing (section 3), another concerning object individuation and identity in early infancy (section 4). Section 5 restates the tension between the Relational View and Sortalism on both conceptual and empirical grounds. Concluding remarks are in section 6.

2 Sortalism

2.1 Sortalism Introduced

In this section I aim at answering some interrelated questions. For starters, I follow Wiggins (1967, 1980, 2001) in taking sortals to be concepts, thus setting aside the debate concerning what kind of entities they are[5]. Still, what do sortals do? What are the reasons for claiming that sortals play a fundamental role in defining singular mental states?

When it comes to their alleged theoretical role, sortals seem to be necessary for us to make sense of how certain instances of thinking are possible[6]. Firstly, they are necessary in providing an answer to the question 'what is it?' (where 'it' refers to a thing of a certain kind). Secondly, they complete the question 'How many … are there?', regarding the enumeration of items of a certain kind. Sortals thus seems to shed light on two different notions of identity: a qualitative one and a numeric one.

In the qualitative sense, a sortal delineates a certain kind of entity. For example, if one asks 'what is it' referring to an armchair, the relevant kind would be the class

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[5] Alternatively, Geach (1962) and Quine (1960) claim that sortals are predicates, Strawson (1959, 168) that they are Universals. For the purposes of this paper, the details are irrelevant (for introductory discussion, see Grandy (2007))

[6] Once again, I am restricting myself to a subset of what sortals could do. For example, sortals are usually taken to specify the 'essence' of an object, under a certain understanding of the term see Locke (1970, bk. III, ch. III, 15). Important questions discussed in the literature include: whether identity holds only under a sortal or whether combining sortals with other sortals (via predication or the introduction of logical constants) results in a complex sortal concept (see Stevenson (1975)). I am not going to deal with any of these topics here.

of chairs or artefacts, more broadly. Now, the notion of identity could be misleadingly construed. First, *identity*, in general, must not be confused with constitution. The armchair is constituted by certain materials, wood, fabric, etc…, but it is not identical to them (see Wiggins 1967, 1980, 2001). Second, *qualitative identity* must not be read as a relation between two objects, as in *a* and *b* are qualitatively the same if and only if they fall under the same concept, e.g. CHAIR or ARTEFACT, as this might hold for non sortal concepts as well, like RED.

The relevant notion of qualitative identity is given by the conditions under which an object remains the object as it once was (or simply persists). The trouble is to specify the relevant sense of persistence. I intend to provide different ways in which it can be cashed out along the paper, but for now I would like to focus on a very basic case: spatiotemporal continuity. Suppose the subject is looking at a ball moving through her visual field. This scenario can be described as sequential experiences of seeing a ball at adjacent places at successive times. So what makes it an experience of a single object that moves in a unified way? The sortalist's answer lies on sortal concepts: they are the cognitive structures that introduce object persistence in experience. Since things that fall under MATERIAL OBJECT (or under BALL) move in spatiotemporally continuous paths as an unified entity, experiences that could be regarded as being about distinct things are unified as pertaining to the same causal source. From this, we can conclude two things. The relevant notion of qualitative identity is reflexive, that is, it holds between an entity and itself. Second, I will begin my exposition of the issues that follow by assuming a minimal or weak version of qualitative identity: an object persists (i.e. it remains the same as it was before), if it moves as a whole in spatiotemporal continuous paths. An alternative (i.e. non-minimal or strong) version will be introduced in a more appropriate point of the paper.

When it comes to numeric identity, sortals seem to be involved in singling out specific individuals. Consider again someone looking at a typical rural landscape: hills and a river flowing amongst them. Now suppose the following question is asked 'How many things do you see?'. The question is indeterminate, for it is compatible with an infinite number of answers. Anything can be considered a 'thing' in some sense or other: the sky, its colour, atoms, the way they are put together, etc... It seems that in order to single out an entity in thinking the subject needs a criterion; one that is provided by sortal concepts. Now, consider the question 'How many rivers do you see?'. An appropriate answer would be 'one', even though nothing in the perceptual relation has changed. Cases such as this motivate the classification of RIVER as a sortal and THING as a non-sortal concept.

This was just a sketch of the motivations for sortal concepts. In what follows, I shall briefly review some arguments for Sortalism.

2.2 Arguments for Sortalism

In order to motivate the claim that sortals provide identity and individuation conditions of specific entities, three arguments will be reviewed: the counting argument, the argument from divided reference and the re-identification argument. This will provide a better understanding of the theoretical notions of individuation and identity conditions.

The counting argument goes back at least to Frege (1950). He asks us to consider a scenario where someone is looking at a deck of cards. Now, the same perceptual experience could be taken as eliciting either a representation about a single object – the deck – or a mental representation about fifty-two numerically distinct objects – the cards. One could say that both possibilities are instances of singular thinking, for the thought would be about *that* specific deck or about *those* specific cards. Still, how is it that perceiving a single object can elicit two different thoughts? Frege's answer relies on the idea that concepts are necessary in order to count (i.e. to numerically individuate) objects. The counting argument takes the premises that (i) if perceptual relations were sufficient for individuating object-dependent mental states, then perceiving a scene containing a single object would give rise to a unique thought, and that (ii) perceiving a scene containing a single object can elicit thoughts about the object or about the discrete parts that compose it, to entail the conclusion that (iii) perceptual relations are not sufficient for individuating object-dependent mental states. It follows, then, that sortals are needed for object individuation.

The argument from divided reference was championed by Quine (1960). As mentioned earlier, consider a person looking at the water of a river and thinking that the water looks refreshing. It seems natural to ask the following question: is there a specific thing that this person's thought is about? It is certainly about something, but there does not seem to be a particular entity that is 'singled out' in thinking. In the words of Quine (1960, 91), sortals are necessary for 'dividing reference', that is, carving the environment into sets of discrete entities, something which mass concepts do not do. This idea can also be read off the example used in his thesis of the inscrutability of reference (Quine, 1960, ch. 2). Consider a linguist in fieldwork mastering an entirely alien language. While pointing to a white rabbit that just emerged in the scene, the native speaker says 'Gavagai!'. Apparently, there are various hypotheses that are consistent with the evidence available to the linguist: 'gavagai' could be taken as synonymous with 'fur', 'whiteness', 'undetached rabbit-part', and so forth. Similarly, the perceptual experience can be construed as being about a certain rabbit, but it also could be about the rabbit's colour, shape, parts and so forth. In order to rule out relevant alternatives, Quine argues that sortal concepts must be applied to the stimuli. What makes that

experience about a rabbit is that it has been organized under the concept RABBIT or ANIMAL[7]. To sum up, the argument from divided reference takes two premises, namely, (i) that sortal concepts are necessary to give us discrete entities and (ii) that discrete entities are the objects of singular thoughts, as entitling the conclusion (iii) that sortal concepts are necessary for instances of singular thinking.

Finally, Strawson (1959) gave a transcendental argument for Sortalism. First, he urges us to consider what kind of entities we are able to identify and re-identify (i.e. identify as the same previously identified thing) demonstratively. Intuitively, these are medium sized three-dimensional, bound, solid objects existing in space and persisting through time. For example, I can identify the chair that I am now sitting on as the same chair I sat on yesterday and also identify a rolling ball as the same ball in adjacent spatial positions at successive times. Now, the ability to re-identify requires that material objects are perceived as enduring, at least briefly, in space-time. However, perception does not provide the subject with the endurance conditions that material objects possess. Reasons for this have been mainly spelled out in Quine's argument: being *en rapport* with certain shapes, colours and textures does not fully give us the experience of an enduring thing. Thus, the relevant persistence conditions must be captured by a basic conceptual structure, under which three-dimensional, bound, persistent objects fall, namely, the sortal MATERIAL OBJECT or BODY (see Strawson, 1959, 31-40, 168). Thus, the argument from re-identification moves from the premises (i) that the ability to identify and re-identify objects in space-time underpins object representations, and (ii) that the ability to identify and re-identify objects requires the sortal concept MATERIAL OBJECT, to the conclusion (iii) that object representation involves the sortal concept MATERIAL OBJECT.

2.3 The Roles of Sortalism

All three arguments support the view that sortals are necessary for thinking about a currently perceived object. However, these arguments disagree when it comes to which concept does the job. This is obviously connected to the extent to which the persistence conditions of a given object must be specified. In Frege's example, concepts such as DECK or CARDS are the ones responsible for singling out the relevant objects and they both include more fine-grained information about the kind of transformations the denoted objects can undergo, when compared to Strawson's MATERIAL OBJECT is good enough. As mentioned before, I am taking qualitative identity in the minimal sense (preservation of spatiotemporal continuity)

[7] This thought experiment has been very influential in acquisition studies of the hypotheses that pre-linguistic children form about the meaning of words (see Macnamara (1972, 1982)).

as my starting point, and I will reserve the discussion about whether persistence conditions must be specified by specific sortal concepts for latter (section. 4). With this caveat in mind, it is worth distinguishing at least two things for now:

Sortal Individuation: Cognitively individuating a specific object requires the apparatus of sortal concepts.

Sortal Identity: Recognizing the conditions under which objects remain the same requires the apparatus of sortal concepts.

It is worth noting that the definitions above are just provisional. Again, I am taking *Sortal Individuation* and *Sortal Identity* as minimally specified by spatiotemporal continuity; hence a sortals such as MATERIAL OBJECT is the minimal conceptual apparatus. Having introduced Sortalism, I will try to understand what a cognitive relation along Russellian lines might be like from an empirical standpoint. Then, I will assess whether *Sortal Individuation* and *Sortal Identity* really hold.

3 Individuation and Identity in the Early Visual System

3.1 Acquaintance and Cognition

As Evans (1982, ch.4) pointed out, one of the main problems with Russell's defence of knowledge by acquaintance concerns how it should be cashed out in theoretically interesting ways. If we take the talk about *cognitive* relations seriously, empirical considerations become the cornerstone of the Relational View. Focusing on the visual system, the question could be posed as follows. How does the visual system represent information concerning object identity (both in the numeric and qualitative sense)? Now, since *seeing* something might depend on shifting attention to that object, I would like to make some caveats concerning attentional processes, before reviewing, in the reminder of this section, behavioural studies that might shed light onto how medium-sized objects are represented by the early visual system.

3.2 Visual Attention

One of the first difficulties that the visual system faces is the problem of informational load. Olshausen and Koch (1995) estimate that information around the order of 10^8 bits per second hits the optic nerve. Processing every single bit of information would consume an enormous amount of cognitive resources. Nature's answer to this problem rests on attention. By selecting which parts of the visual

display to focus on and which parts to ignore, we save in processing effort. But how does attention work in human cognitive life?

There are two types of stimuli that can drive, that is, serve as input to, shifts of attention: exogenous or bottom-up stimulation and endogenous or top-down stimulation. The former is clearly exemplified when a medium-sized object moves rapidly through the subject's visual field. The latter is usually triggered by an agent's intentions or mental states, as when shifting my attention to a specific book in the shelf is caused by my desire to read it[8].

When it comes to top-down stimulation, it could be argued that the mental states responsible for triggering the shifts of attention are re-used in the individuation of the objects attended to. In the previous example, the concept BOOK would shift the subject's attention to a particular region in the visual field, but it could also influence lower-level cognitive processes concerning what is being looked at, that is, it could enhance sensitivity to the particular kind of shape, contour and texture that books have. Based on this, one could put forward a *top-down argument* for Sortalism (or Conceptualism, more generally), which runs along the following lines. If a conceptually structured mental state causes a shift of attention, then such concepts serve to identify which objects are attended to. If one holds that the identity conditions of specific objects are intrinsically given by sortal concepts (Sortals Identity and Sortal Individuation), then attending to specific objects would involve sortal concepts. This hypothetical argument, however, misses the point, for it does not establish that *every* shift of attention to an object involves mental states structured by sortal concepts. Yet, the hypothetical move reveals an interesting constraint on anti-sortalists: experimental designs that are intended to prove Sortalism wrong must control for possible top-down influences employing sortal concepts[9]. In what follows, I will look at three experimental paradigms that control for such influence.

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[8] In addition to this distinction, shifts of attention can also be behaviourally overt or covert. Moreover, there is a huge debate about how information gets discarded by focusing attention to a certain region of the visual field. Early selectionists (Broadbent, 1958; Neisser, 1967) claim that the relevant kind of information gets selected quite early (i.e. a filter of information), whereas late selectionists (Deutsch and Deutsch, 1963; Van der Heijden, 1981; Allport, 1987) argue that this is done at a later stage. Such debate transcends my purposes here, (for a nice review, see Driver (2001)).

[9] Note that this is a weak claim, as this hypothetical argument for Sortalism relies on only a subset of top-down stimuli: mental states structured by sortal concepts. I am happy to acknowledge that top-down influence emerging from other mental or brain states can influence bottom-up processing: as when somebody looks at a region of space expecting something to appear, or when segmenting the shapes in a picture is almost impossible without the aid of a prime from a version of the picture in higher resolution (see Gilbert and Sigman (2007) for a

3.3 Subitizing and Object Individuation

When subjects are presented with a small number of items in a visual display and asked how many objects there are, they give fast, precise and confident judgments: a phenomenon known as *subitizing*. Alternatively, when the number of items is not so small, the speed, accuracy and confidence of the judgments decrease significantly. If the individuation of the objects in the display is achieved by attending to each one in turn, the difference in confidence, accuracy and speed in judgments would be correlated linearly with the number of displayed items. However, Trick and Pylyshyn (1994a, b) falsify this hypothesis. If the items exceeds a certain number (4 or 5), accuracy and confidence decrease dramatically. Additionally, response times receive the huge increase of 250ms – 350ms per item in the display after the fourth, when compared to the 10ms-40ms per item in the 'subitizing' range (up to 4 items). This finding suggests that individuating up to 4 or 5 items is achieved by a mechanism different from the one involved in enumerating or estimating a larger number of objects.

In order to gain insight into the kind of mechanism that might be at play in the fast, reliable and accurate individuation of a small number of items, Trick and Pylyshyn (1994a, b) attempted to delineate the conditions under which subitizing is possible and the conditions under which it is not. The experimental paradigm they used had three conditions: (i) same size condition, (ii) different size condition, and (iii) concentric condition. In the same size condition, subjects were presented with a display containing rectangles delineated by four edges in a bounding contour. All of them had the same size, which could be small, medium or large, and they were located in different locations in the display. In the different size condition, the setting was almost the same, the only difference being that rectangles could be of different sizes. In the concentric condition, all the rectangles had different sizes but they had the same centre. In each case, subjects had to simply say how many items were displayed.

In this study, Trick and Pylyshyn found that subitizing is possible in (i) the same size condition and in (ii) the different size condition, but not in (iii) the concentric condition. Moreover, items that are too near one another or that are individuated by an instruction like 'Identify items on the same curve!' cannot be subitized (see Pylyshyn (2007a, section 1.4.3)). This seems puzzling, for the items presented in the concentric condition were within the subitizing range. Trick and Pylyshyn have suggested that the visual system individuates objects by using coarse-grained

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neuroscientific review of the top-down/bottom-up distinction). This kind of top-down influence, however, does not help the Sortalist. For attempts to draw this distinction by distinguishing processes 'locked' in a pathway from processes that receive information from different pathways see Raftopoulos and Muller (2006).

information about their location in the display. If the items are located in the same informationally salient region, then a mechanism of attention would have to focus on the concentrically positioned binding contours in order to determine which object is which; in other words, shifts of attention would have to spread serially. If these remarks are on the right track, subitizing employs a mechanism of parallel attention (see Pylyshyn (2007a, 28), Dehaene (1997)).

Trick and Pylyshyn's suggestion seems to be further supported by neuroanatomical evidence from patients with Balint's syndrome. This condition is characterized by a general deficit in focal attention, generated by lesions in the post parietal cortex. Symptoms include the inability to see all the objects in the visual field simultaneously, difficulty in coordinating hand and eye movements, and the inability to shift attention towards another object. Dehaene (1997) reports that a patient with this condition failed to enumerate objects outside the subitizing range (more than 4 items) either by ignoring certain objects in the visual display or by counting the same objects multiple times. Nevertheless, the condition did not impair the ability to subitize.

In order to account for the data, Trick and Pylyshyn propose that subitizing is done by a mechanism of parallel object individuation that assigns visual indexes to objects in the visual display. Pylyshyn calls such indexes 'FINgers of INSTanciation', 'FINSTS' for short, to remind us that they function as pointers. There are two fundamental characteristics of FINST assignment. First, they are assigned essentially in a causal, data-driven way, that is, information flow is strictly bottom-up, coming directly from the objects perceived. Thus, saying that the visual system assigns indexes could be a little bit misleading. Rather, the external objects themselves 'grab' certain indexes given the way human cognitive architecture has evolved. According to Trick and Pylyshyn (1994a, b), there are two conditions that must be met for this 'grabbing' to occur: objects must have bounding contours and they must be located relatively away from each other. There is an important way in which such conditions differ from sortal concepts: they are stringent constraints on the information that serves as input to visual processing - if they are not met, visual indexes are not assigned. Pylyshyn claims that the representation condition on the index assignment mechanism works, in the words of Marr (1982), as a 'natural constraint': if requirements imposed by the architecture of the cognitive system (e.g. module, network) are not met, the system cannot deliver its output. In the case of sortal constraints, on the other hand, if something does not fall under a given sortal concept it could be represented either by (i) a different sortal concept, or (ii) by a non-sortal concept. I will say more about this important distinction in section 5.

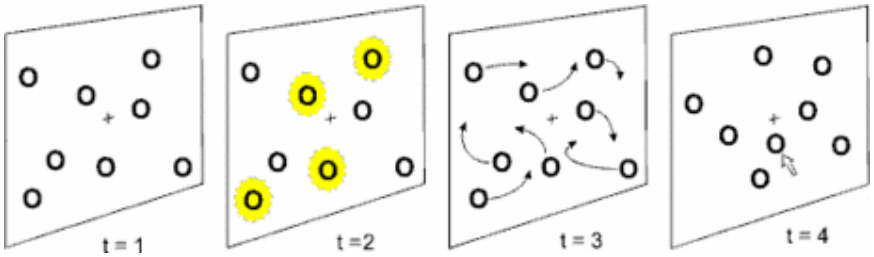
It seems then that some of the sortalist's claims are not borne out. Information concerning the visualized objects (up to 4-5) is processed in parallel and if it meets

certain conditions, objects are individuated by the assignment of visual indexes or FINSTs. This suggests that sortal concepts are not necessary for object individuation, falsifying *Sortal Individuation*. Yet, another claim, *Sortal Identity*, remains to be tested: whether sortals are involved in representing object identity in the qualitative sense, i.e. the conditions in which they persist in time and space. In order to assess this, I will look at another experimental paradigm developed by Pylyshyn: Multiple Object Tracking (MOT, henceforth).

3.4 Identity in Multiple Object Tracking (MOT)

A typical MOT experiment runs as follows. Subjects are presented with a display containing two sets of objects: (i) target objects, which are supposed to be tracked during the experiment, and (ii) non-target or distractor objects (t=1). Unsurprisingly, the number of target objects does not exceed four. After the display is introduced, targets usually blink on and off a few times so they can be distinguished from non-target objects (t=2). After that, targets move around the visually identical non-targets for 10 seconds (t=3). At the end of the trial, a given object is pointed at – the probe – and subjects are then asked whether the probe was in the target set (t=4). According to Pylyshyn (2007a, 35), the task was extremely easy (around 90% accuracy) when up to 4 targets and a further number of non-targets were moving randomly, even passing in front of each other, at a reasonable speed (4-6 seconds to cross the computer screen on average, but that varied in different trials). By what means do subjects track these objects?

Figure 1



Pylyshyn 2007b. Trial Sequence. Multiple Object Tracking. Scholarpedia, 2(10):3326. Available from: http://www.scholarpedia.org/article/Multiple_object_tracking [accessed online October 2009].

As mentioned in the argument from re-identification, tracking or attending to an object as it moves in the display would seem to inevitably involve sortal concepts so that the object can be represented as the same object visualized at the beginning of the trial. Since the persistence conditions of material objects are captured by spatiotemporal continuity at successive times, one *could* cash out a sortalist model

of object tracking, under MATERIAL OBJECT, by claiming that subjects track multiple targets by storing their initial locations in memory and updating these continuously, as attention shifts to each successive position of the targets in turn. According to Pylyshyn and Storm (1988), this proposal has two related difficulties. First, if objects move faster than the time that serial shifts of attention normally take, a huge decrease in performance would be expected. Secondly, if a target object is not at the stored location any longer, but a non-target is nearby, then updating the object's location could lead to greater probability of target/non-target confusion (see Pylyshyn (2007a, 37)). A tracking model which incorporates both factors - using the average for humanlike shifts of attention - yields a prediction of 30% tracking performance. However, Pylyshyn and Storm found that subjects performed at an accuracy level of 87%. Therefore, it appears that the parallel mechanism of object individuation could also be involved in representing objects' persistence conditions.

There is another way in which tracking might be done. By detecting the presence of certain shapes (e.g. squareness) and colours (e.g. redness) in the display, the visual system could track the object by tracking the features that co-occur in a given location. Although the hypothesis does not support Sortalism, since features, such as redness, might not provide any criteria for individuation, it seems to support Descriptivism in the sense that our experience of an object would amount to the experience of its properties. Such a descriptivist strategy would predict that (a) if objects have distinctive features, (e.g. three objects consisting of one triangle, one circle, and one square) tracking them would be easier; and (b) if the objects' features remain stable during the trial, tracking would be easier as it does not require updating of features in memory. Dennis and Pylyshyn (2002) tested this and showed that having a uniquely discriminating shape does not improve tracking performance. Conversely, performance is no worse when objects' colours and shapes change randomly during the trial. Bahrami (2003) and Scholl et al. (1999) report that sometimes subjects were not even conscious of the object's changes. This further suggests that the objects were taken to be the same regardless of changes in their properties; that is, object tracking is not the same thing as feature tracking.

The results above strongly suggest that sortal concepts are not necessary for re-identifying the same object as it changes its position through time (the weaker notion of qualitative identity I have been assessing here). The MOT paradigm indicates that once the targets blink, the early visual system assigns an index to the relevant objects in the display and then identity of the object is preserved under the identity of the index. Change in features would not change index assignment. Again, it must be noted that there are certain conditions not only for assigning visual indexes, but also for preserving them. For example, Scholl et al. (2001)

showed that objects' parts cannot be selected and tracked by FINSTS; also, if objects liquefy and 'pour' from one place to another or if they move in a wormlike stretch and slink way, tracking is not possible (vanMarle and Scholl, 2003). However, if target objects briefly disappear as if they were passing behind an invisible occlusion, tracking is still possible (Scholl and Pylyshyn, 1999). Moreover, tracking is successful even if objects change the direction of their movement up to 60 degrees while occluded (Franconeri et al. 2006). Thus, in addition to the conditions of objecthood (i.e. bounding contour, sufficient spatial segregation) unearthed by the subitizing studies, the MOT experiments suggest that FINSTs can capture the weak notion of identity through space-time by a condition on object movement (i.e. spatiotemporal continuity). Interestingly, such object representations even survive momentary occlusions of the causal source.

At this point, one could note the following. One of the alleged conditions of objecthood is a binding contour. Now, visualizing binding contours depends on featural information, such as shapes and edges. On the other hand, the assignment of visual indexes heavily draws on information concerning objects' location in the visual field. Thus, the following proposal could be made. First, features are detected in the visual field, which can be paraphrased as 'There is redness around' or 'There is squareness around', for example. Then, information concerning the object's location could be fed into this representation, so features belonging to the same object can been 'conjoined', such as, 'there is redness and squareness at position x in visual field'. Thus, singular objects would be visualized as bundles of information, and object identity could be preserved under identity of the bundle. This approach would be very much in the spirit of Anne Treisman's Feature Integration Theory (FIT) (Treisman and Gelade (1980), see also Campbell (2002); Clark (2004)). Then again, one may question whether bundles of features are represented at the conceptual level, at which information concerning the object's bounding contours is captured under a sortal (SQUARE, say), or at the nonconceptual level, at which an argument for Descriptivism, but not Sortalism, can still be made. Whichever way is taken, location would be the decisive factor in representing objects.

In order to test the role of location in object individuation, Blaser et al. (2000) asked a simple question: can humans track objects in the same location? In order to provide an answer, they devised a trial that consisted in tracking objects in feature-space, instead of physical space (within which they were static). The objects employed were two coloured, round, striped figures, called 'Gabor patches', one of which was superimposed on the other. As the Gabors had transparent backgrounds, the set of features pertaining to each object could be correctly identified. Now, subjects had to track movement in feature space, that is, track changes in the set of features of each object, which could be independently modified in the following way. Gabors could change colour, stripe width, or stripe orientation (moving

clockwise or anti-clockwise). It would be possible for objects to occupy the same position in feature space with regards to one or two features (they could have the same colours and stripes), that is, at least one feature should remain distinctive.

Figure 2

Erik Blaser. Gabors moving in feature space. Available from: http://web.mac.com/visionlab/Blaser/Blaser_home.html [accessed online October 2009].

Initially, subjects were designated a target Gabor as both of them 'moved' through feature space. After the trial, subjects picked out the right object with an accuracy rate of 90%, which strongly suggests that tracking targets did not engage an individuation mechanism based on spatial location. However, the question whether individuation is achieved by feature-based or by object-based mechanism theories of selection remains. If individuation depends on a feature-based mechanism, attention would not spread to other features pertaining to the same objects, whereas the object-based theory predicts that it would. To test this, Blaser et al. (2000) introduced pairs of small 'jumps' in the feature 'trajectories' of the objects in the display (i.e. sudden changes in orientation or colour, say). Such jumps were totally unpredicted, which has the advantage of working as data-driven stimulation and of avoiding the worries expressed by the top-down argument for Sortalism (see 3.2). The pairs of sudden feature changes could either belong to the same object or to different objects. The task was simply to detect any 'jump'. In this experiment, subjects made faster judgements when the sudden changes belonged to the same object than when they belonged to different objects (see Pylyshyn (2007a, 41)). The selection of features seems, then, to be object-based.

However, one might argue that in the absence of spatial information, the individuation of the Gabors is done by featural information. Thus, at an initial stage, subjects may be confused as to which features belong to which object, but as soon as the patches start moving, movement continuity could be used as a method for bundling features together. Once visually indexed, the bundle's identity would depend on the identity of the visual index, and the causal link between subjects and object would permit the constant update of features. Of course, this individuation method would be more costly when compared to the individuation of objects based on spatial information, as featural information would have to be encoded in order for FINSTs to be assigned. Differently from subjects' insensitivity to objects' properties which subitizing experiments indicated, tracking through feature space

must update the successive changes in objects' properties through time. In this way, visual indexes, that usually state information concerning bare objects, give birth to representations in working memory that store information about the object's properties. Kahneman et al. (1992) conducted a series of studies that motivated object dependent representations that store descriptive (featural) information while still preserving a bare object bias: *object files*.

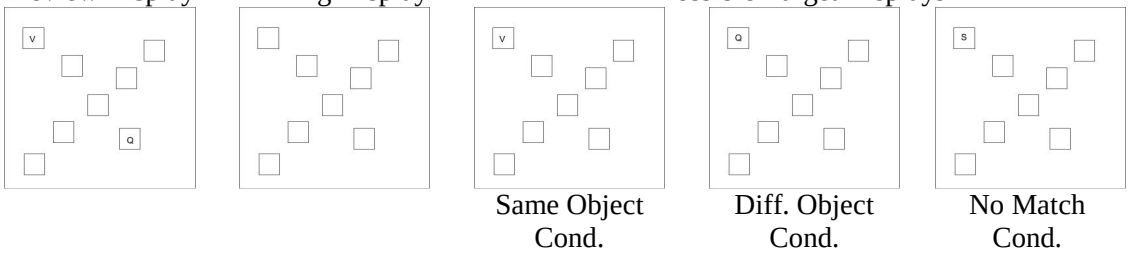
3.5 Object Files

An object file is a bare-object representation in working memory that collects information about objects in the distal environment. The name comes from the idea that data causally derived from an object enters into a specific file on it. Evidence in support of this form of representation was brought to light by Kahneman et al. (1992). Nowadays, the literature seems to agree (see Pylyshyn (2007a, 38-9)) on the idea that index assignment (setting up a mental representation corresponding to the object that causally bring is about) is the first stage in object file creation, a cognitive operation that Kahneman et al. (1992) labelled *Correspondence*, which is also responsible for selecting a previously created file. Besides *Correspondence*, object-file theory postulates two other cognitive operations. *Impletion* checks whether the re-attended stimulus has changed or not. *Reviewing* updates the object file with new information. Although, I am following the literature in taking object-files to be an informationally enhanced version of FINSTS, the same points about the latter can be made about the former: that is, individuation and identity of the object is captured by individuation and identity of its corresponding file. Thus, there is an important distinction between two kinds of information: one involved in the creation of object-files (or in the satisfaction of a natural constraint imposed by the visual system, in Pylyshyn's words), another that is written under the file, such as information representing the object's features. Evidence for this dual function of information – bringing about certain object-dependent mental representations and encoding features of the environment – was unearthed in the following priming study.

Kahneman et al (1992) presented a series of displays containing small boxes (around 6-8 in number). In the first display, called the 'preview display', stimulation consisted of two letters occurring in two of the presented boxes. For instance, a 'v' would be in a box occurring in the upper half of the display, whereas a 'b' would be in a box occurring in the bottom half. At this point in processing, distinct objects files about the two boxes containing 'v' and 'b' would have been created. The preview display would then be followed by a 'linking display' in which all boxes would be empty, as if the letters had been 'deleted' (interstimulus interval). Finally, Kahneman et al. (1992) tested three conditions involving a 'target' display (target stimulus), in which only one of the two previewed boxes

would appear. In the *same object condition*, the same box containing the same letter in the preview display is now displayed (e.g. the box containing a 'v' in the preview display is shown in the target display), as if the other letter (e.g. 'b') had been simply deleted from its original box. So, there is no *Reviewing* involved in the target box. In the *different object* condition, a single previewed letter occurs in a previously previewed box, but the box that now contains a 'v' previously contained a 'b', for example. In this condition, *Reviewing* is involved in modifying the object file created in the preview display by entering into it previewed information stored in the other object-file. In the *no match condition*, a previously previewed box containing a novel letter is displayed. This involves *reviewing an object file* with non-previewed information. It must be noted that the location of the boxes in the display, that is, the 'frame' where the boxes appeared, was kept the same throughout the change in stimulus, in order to allow a perceptual link from preview to target displays. Subjects' task was to name the visualized letter in the target display. Response times were measured, which then allowed for the comparison amongst different effects.

Figure 3 – One of the different kinds of trials used in Kahneman et al (1992)



Based on Kahneman et al. (1992)

Kahneman et al.'s theory of object files would predict quicker response times in the same object condition when compared to other conditions, for no reviewing would be involved. It would also predict that the response times in the different object condition would be faster than the no-match condition since reviewing in the former case would put already previewed featural information into the object file (a priming effect), whereas, in the latter case, it would add new information. Kahneman et al (1992) found robust evidence to support the first prediction, but not the second (although later studies supported both predictions, see Gordon and Irwin 1996, 2000). The issue that I want to address now is the following. What changes in stimuli would *Impletion* and *Reviewing* be sensitive to? If the box in the preview display contained a lowercase letter ('b', for example) and the box in the target display contained the same letter in uppercase ('B', for example), would the initial

object file be modified? This goes to the heart of the type of information that is written into files, that is, whether they only concern perceivable properties or some properties of a higher cognitive order.

There are two studies that address this question. Gordon and Irwin (1996) used exactly the same experimental paradigm as Kahneman et al. (1992). The difference is that they only displayed frames contained two boxes. The preview had two boxes containing words, instead of letters. In the linking display the words were deleted from the boxes and in some cases the boxes would rotate in a way such that they would end up side by side. The target frame had the same conditions: *same object*, *different object* and *no match*. In the (1996) study, Gordon and Irwin were interested in checking whether lexical information would be represented under the file. To test for this they introduced a case difference in the same object condition, so if the previewed word is 'doctor', then the target word would be 'DOCTOR'. The hypothesis that changes in letter case do not make any difference to the same object preview effect was confirmed, suggesting that some more abstract form of information is written into the file. Gordon and Irwin (1996) further tested to see whether there would be same-object preview effects if the target word is semantically related to the preview word. Synonyms like 'cab – taxi', superordinates like 'robin – bird', and related words like 'doctor – nurse' were tested, but no priming effect was found. This suggests a limit to the amount of information recruited by the file. In another series of studies, Gordon and Irwin (2000) used the same experimental paradigm as before, but this time they tested whether the box containing the word 'fish' in the preview display followed by a box containing a picture of a stereotypical fish in the target display would have the same object preview effect. This hypothesis was also confirmed. The result is puzzling. Even though information stored in object files seems to be abstract in nature, the possibility that full lexical types are accessed cannot explain the lack of priming effects between semantically related words.

3.6 Interim Conclusions

In conclusion, the studies reviewed provide an answer to the question about how the visual system represents medium sized objects. Identity in the numerical sense (individuation), crucial to the counting argument and the argument from divided reference, as well as in the minimal qualitative sense, crucial to the argument from re-identification (see section 2.2) can be captured by bare object representations (i.e. FINSTs, object-files). Now, proposing such form of mental representations motivates a split in the representation conditions of medium sized objects along the following lines:

Informational Distribution: information causally deriving from perceiving an object is used to bring about an object dependent representation (e.g. by satisfying a natural constraint) *or* is encoded as one of the object's visual properties.

In order to highlight the different roles played by information in the visual system, one has only to consider what happens in cases of misrepresentation. If the natural constraint is not satisfied, no index is assigned (or object-file created). This case is illustrated by things that move in a slinky, liquefying and pouring, or disintegrating and reassembling way (vanMarle and Scholl 2003). Subjects are unable to track what is going on. On the other hand, if the visual system mistakenly encodes some of the object's properties, say, colour, one would see a yellow object instead of a red one (see the visual binding errors reviewed in Treisman and Gelade (1980)). If this distinction is in the right place, the individuation and (re-) identification of objects might be captured as a natural constraint. In this case, *Sortal Individuation* and *Sortal Idenity* would be unmotivated. In the next section, I will assess whether an alternative motivation can be provided for such Sortalist claims.

4 Sortalism Strikes Back

4.1 Two Strategies

If *Informational Distribution* is right, there are two conditions for representing medium sized objects. On the one hand, data about an object's location at a time and its movement patterns might satisfy requirements on the creation of a certain mental representation. In this case, visual access to spatiotemporal information about an object brings about a bare object *token* representation: an index, or an object-file *o*. On the other hand, spatiotemporal information about an object could be fully represented by the visual system, that is, representing bounding contours, movement in spatiotemporal contiguous paths, is constitutive of the object representation itself. In this sense, we can think that token representations are only represented under generalised, type-level information, for example, *o*[MATERIAL OBJECT], where the material in square brackets works as a restrictor of a complex demonstrative.

With this is mind, there are four logical possibilities about the role of an object's location at a time and movement patterns in object representation. Spatiotemporal information can (a) bring about certain object tokens *and* articulate types under which such tokens occur, (b) *not* bring about certain object tokens *nor* articulated as types under which object tokens occur, (c) *not* bring about certain object tokens *but* articulated as types under which object tokens occur, (d) bring about certain

object tokens, *but not* articulate types under which tokens occur. Now, let me make theses positions clearer, beginning by the end.

Position (d) seems to be taken by Pylyhsyn (2007a) and, maybe, Kahneman et al. (1992). As soon as objects with bound contours that move in interconnected paths are visualized, index are assigned or object-files created, but information used to satisfy the natural constraint is not encoded by such object representations. They are bare *visual tokens*. This view has been presented in detail in section 3. Position (c) denies that spatiotemporal information is captured by a natural constraint. According to this view, object representations must invoke type-level information, this could be paraphrased as the subject's knowledge that *there is objecthood around*, but the subject is unable to track specific objects in space. The data showing a form of bare object bias, reviewed in section 3, raise immediate difficulties for this view. For this reason, it does not seem an interesting alternative to be pursued. Position (b) denies the alleged privileged status that spatiotemporal continuity has on the individuation and (re) identification of objects. Both data reviewed in section (3) and Strawson's motivations for MATERIAL OBJECT are counter-arguments to this position. However, it can be safeguarded from these objections by making a distinction between the object representations required for simple bodily action (say, tracking, grasping, avoiding and object) and demonstrative thought *proper*. Whilst FINSTS and object-files might underpin the former, they do not underpin the latter. In order for this position to get off the ground, it must motivate the idea that demonstrative thinking proper is intimately connected to fine grained information about objects' persistence conditions. I call this view 'The Identity-over-Individuation strategy for Sortalism' and I will take a closer look at it in section (4.3). Finally, position (a) claims that spatiotemporal information could be used by the early-medium visual system to assign bare token representations (FINSTs, object-files) but given the incremental nature of processing, it might be the case that visual tokens get represented under type information, such as MATERIAL OBJECT at higher cognitive levels. For this view to take off the ground, evidence of behaviour that cannot be explained solely by object-files must be provided. I call this view 'The Incremental Strategy for Sortalism'. I introduce the empirical motivations for it in the next section.

4.2 The Incremental Strategy - Evidence for Sortalism?

4.2.1 Data Review: A series of experiments conducted in the early '90s brought evidence in support of another cognitive mechanism for object individuation and identity. These experiments used the method of violation of expectancy in infants from 2.5 months to 36 months old. This experimental setting is interesting for two reasons. First, if object representations underpin the interaction amongst complex mental states (beliefs, desires, expectations, etc...), an explanation of such

interactions in structural terms seems to be motivated. If object-files cannot do the job, then evidence for sortalism might be provided. Second, children of that age are at the onset of language learning, providing the appropriate locus for inquiring into the relations amongst the acquisition of specific sortal concepts and the individuation and identification of objects. The experiments ran along the following lines. Children were presented with events which had two possible outcomes: an expected one and an unexpected one (according to adults' understanding of the world). If children look more at the unexpected outcome, it implies that their expectations about the way things turn out are adult-like. The theoretical task then would be to speculate what kind of cognitive mechanism generates such expectations (for groundbreaking work see Baillargeon (1987); Spelke (1990)).

In Spelke et al. (1995) the following experimental paradigm was used. First, two spatially separate screens were introduced. An object (rubber duck) was removed from behind screen one and shown to the infant. After that, the object was put back in its original place. The same process happened with screen two: another occluded object (rubber duck) was removed and shown to the infant and then replaced behind the screen. Finally, both screens were removed revealing either one of two possible outcomes: the expected outcome displaying two rubber ducks or the unexpected outcome displaying one rubber duck. The authors found that 4.5 month-olds looked more at the unexpected outcome, suggesting that they used the spatial gaps between screens to determine how many rubber ducks were occluded. In addition to spatial gaps, 8 month-olds (Needham and Baillargeon, 1998) start to use Gestalt principles to individuate objects. For example, although the horseman and the horse seem to move as a whole, differences in their shapes and colours may be used to distinguish one from the other. These findings were used to motivate what Spelke calls 'principle of cohesion', that is, an object is a bounded chunk of matter that preserves its connectedness and boundaries as it moves through space.

In an experimental setting very similar to this one, Huntley-Fenner et al. (2002) assessed infants' expectations concerning sand piles. Sand was poured on the stage floor and the pile was hidden behind a screen. Then, a second, separate, screen was introduced and more sand was poured behind it. After the screens were removed, two outcomes were possible: two sand piles (expected) or one sand pile (unexpected). 8-month-olds were indifferent to either outcome. According to Huntley-Fener et al. (2002), children were indifferent because the concept SAND is not a sortal, hence it does not provide criteria for individuation and identification of objects.

Going beyond perceptual processes explainable by a principle of cohesion, Baillargeon et al. (1985) investigated children's expectations regarding the behaviour of objects in motion. Four-month-olds saw an object being placed behind a drawbridge-like screen. As the screen rotates backwards, two outcomes are

possible. The screen could either stop roughly at the position where the object is (expected outcome), or it could come all the way down to the ground (unexpected outcome). As before, four-month-olds looked more at the unexpected outcome. The finding supports two principles concerning infants' conception of physical objects. First, infants do not expect objects to disappear at one point and reappear at another (principle of continuity). Second, infants expect objects to constitute physical barriers to the movement of other objects (principle of solidity).

In order to test whether children's expectations were based only on visual stimuli, Spelke (1990, 44-5) blocked the infants' visual field with a screen while letting them play with two rings that may or may not be connected by a bar. After experiencing the rings as if they were parts of the same object, the screen would be removed and two outcomes are possible: either the rings were connected by a bar (expected) or they were disconnected (unexpected). Spelke found that children were surprised by the unexpected result, suggesting that infants' expectations applies to stimulation in multiple modalities (visual and haptic, at least).

The conjunction of these principles (cohesion, continuity, solidity)[10]is taken by psychologists to determine the concept SPELKE-OBJECT. Much of the philosophical motivation for this kind of concept is found in the re-identification argument (see section 2.2), and thus SPELKE-OBJECT seems to be an experimentally-grounded version of Strawson's MATERIAL OBJECT or BODY. In the experimental design above, this conceptual mechanism is supposed to work along the following lines.

As the objects are shown to the infant, the SPELKE-OBJECT concept provides a criterion for individuating things. In the Spelke et al. (1995) study, given that the first rubber duck falls under SPELKE-OBJECT, the infant's experience can be described as being of an object, rather than of features or properties. As the duck is put behind the screen, the infant is required to maintain that specific object representation in working memory. The same process would apply for the second duck. Metaphorically, one could describe this operation as performing a primitive form of adding 1 to 1, which creates an expectation of 2 objects. If only one duck is seen after the screens are removed, then at least one of the Spelke principles, in this case, continuity or cohesion, was violated, which explains the longer looking times. Similar explanations apply to the other experiments, (solidity and cohesion for Baillargeon et al. 1985). Note that Spelke sees the set of principles as constituting a *system* for representing medium-sized physical objects. Such a system - alongside systems for representing purpose-oriented self-propelled objects (via the principle of contact, see footnote 10), basic maths, and spatial geometry - constitute families of core knowledge that are taken to be innate in humans and some other animals

[10] In addition to these, there is the principle of contact, which states that only animate objects are self-propelled.

(see Spelke and Kinzler 2007, Baillargeon 2008).

Now, given the form of object representation outlined in the previous section (FINSTs, Object-Files), one might wonder what justifies the claim that infants' expectations *must* be explained in terms of the SPELKE-OBJECT concept. Before proceeding, I would like to make some caveats. It could be disputed whether object files are nonconceptual representations (as Pylyshyn claims) or conceptual representations, that is, object-dependent concepts a la Evans (1982) and McDowell (1984). Clearly, this would depend on one's assumed criteria for conceptuality. The dispute between Object-Files and SPELKE-OBJECT rather rests on whether such object representations are *entirely* object-dependent, so are bare tokens, or must be represented under type information. In other words, the issue concerns whether the conditions for representing visual tokens are captured by a natural constraint (information that brings about certain representations) or by a full-blooded concept, like SPELKE-OBJECT, (information which would be encoded by the object representations themselves). As we shall see in the next question, motivation for taking spatiotemporal information as represented under SPELKE-OBJECT stems from behaviour that potentially could not be explained by visual indexes or object-files.

4.2.2 The Incremental Strategy. In a review article, Carey and Xu (2001) pursue the Incremental Strategy for Sortalism insofar as they see no architectural difference between the object-file mechanism and the conceptual system of object representation just introduced. In order to support their claim, Carey and Xu (2001) present two arguments: one based on the idea that the *informational promiscuity* of perceptually-based mental states can only be explained under type information (as opposed to bare visual tokens), the other based on the idea that the expectations triggered by such states articulate knowledge of the persistence conditions of the relevant kind of object, which again could only by stated in terms of kind-level information.

The first argument is supported by a series of claims. First, given Spelke's (1990, 44-45) finding that infants' expectations hold across modalities, one would assume that the output object-representations are not modality-specific (e.g. visual, haptic). Since conceptual representations are taken to be the common (amodal) currency in cognition, the relevant mental states should be conceptually structured. Riggs et al. (2006) found the same subitizing data (discussed in section 3.3) for the haptic modality and explain it in terms of object-files. But if availability across modalities is evidence for conceptuality, this finding might suggest that there is no relevant difference between object-files and instances of SPELKE-OBJECT. Also, the experiments in (Gordon and Irwin 1996, 2000) suggest that information represented under the files is abstract in nature, further supporting the idea that object

representations are informationally promiscuous. However, given that they found no priming effect between semantically related words, the evidence is not decisive. Second, Carey and Xu argue that infants' success in finding objects behind simple occlusions is motivated by the desire to have them, showing that the output representations figure in belief-desire interactions: 'Insofar as being available to guide volitional action (informational promiscuity) is evidence that a representation is conceptual, these studies suggest that object files are sortal concepts' (Carey and Xu 2001, 208).

Here is the main difficulty for this line of argument, in my view. Both supporting claims depend on the premise that informational promiscuity can only be captured by conceptual representation. It all comes down to what criteria for conceptuality turn out to be well motivated. It could be the case that object-file like representations are available in multiple modalities, but fall below the level of a Fodorian Language of Thought. With regards to the belief-desire interaction, it is worth pointing out that many non-linguistic (i.e. conceptually limited) animals display behaviour that requires psychological explanations involving complex belief-desire interaction. Bermúdez (2003) developed a theory, called 'Success Semantics', which accounts for such interactions at the nonconceptual level. Thus, it seems that the antecedent in Carey and Xu's argument, namely, that informational promiscuity is (sufficient) evidence for conceptual representation, could be challenged, at least. Since arguing what desiderata representations must meet in order to be *conceptual* would be a paper in its own right, here I will leave conceptual/nonconceptual debate aside.

Xu and Carey's second argument runs along the following lines. Infants' success in the experimental tasks suggests that they can distinguish between occlusion and cessation of existence. Now, there is more to that distinction than object tracking, for the conditions under which an object ceases to be are minimally articulated. The distinction is of particular interest because issues concerning cessation of existence usually bear on numeric individuation (more on this in section 4.3). As stating the difference between occlusion and cessation of existence presupposes some form of generalized information, the individuation and identity of objects can only be represented by sortal concepts (type-level information). This fits nicely with the idea that SPELKE OBJECT is integral to one of the systems of *core knowledge*. In order to strengthen their claim, an ingenious experiment was employed.

Xu and Carey (1996) tested the ability of 10 and 12-month-olds to use information concerning the identity conditions to numerically individuate objects. Subjects were presented with a single screen. Initially, a ball was removed from behind the screen, shown to the participant, and placed back where it came from. Then, a duck was removed from behind the screen, shown to the child and then placed in its original position. As usual, the screen was removed and participants would be facing either the expected outcome of a display containing a ball and a

duck, or the unexpected display containing just a ball (or just a duck). Now, there is one important difference between this experiment and previous ones. Since only one screen is introduced (no spatial gap between the locations objects are placed at), the child not only has to represent the object under occlusion, but also consider what might happen with these objects while they are occluded, that is, the transformations that objects of these kinds afford. The task requires no simple effort. Xu and Carey (1996) found that 12-month-olds looked more at the unexpected display, indicating that they 'individuate' objects not only according to SPELKE-OBJECT, but also according to the more specific concepts TOY, DUCK and BALL. Note that if the experiment used different objects, like a chest and a ball, it would be totally natural to expect either the chest and the ball or just the chest as outcomes, given adult-like expectations (i.e. a ball may be placed inside a chest). 10-month-olds, however, looked at both displays for the same amount of time, illustrating that they did not employ more specific conceptual information.

As a follow-up to Xu and Carey (1996), Xu (1999) tested 9-month-olds using the same design with the exception that, as objects were shown to the baby, linguistic cues were also given. At the time that the baby looked at the duck, someone would say 'Look [baby's name] a duck'. The same thing was performed for the ball. In this set up, 9-month-olds looked for a longer period of time at the unexpected outcome, similarly to the 12-month-olds in the Xu and Carey (1996) study. Moreover, Xu (1999) introduced a condition where both the displayed objects were followed by 'Look [baby's name] a toy'. The looking times were not affected by such linguistic stimuli and 9-month-olds looked the same at both unexpected and expected outcomes, which might imply that the concept TOY is not fine-grained enough.

At this point the argument becomes really subtle. Carey and Xu (2001) could be saying either one of two things. On the one hand, they might be suggesting, based on the fact that object-files survive under occlusion (Franconeri et al. (2006)), that object-files and SPELKE-OBJECT concepts accomplish the same cognitive task, namely, to individuate and identify medium sized objects. As mentioned before, there are two difficulties for this move. First the way in which objects are selected by visual attention (section 3.2 – 3.4) as well as the specific object bias unearthed by Kahneman et al. (1992, section 3.5) seem incompatible with a sortalist model in which object *specificity* is explained in virtue of *generalised type-level* information (SPELKE-OBJECT). To put it simply, the data reviewed in section 3 cannot be used as evidence for SPELKE-OBJECT. Second, the move takes for granted that the distinction between survival under occlusion and cessation of existence *must* involve *knowledge that* material objects persist in a certain way (hence type-level information). However, nothing prevents this distinction from being explained by the distinction between situations in which a visual index is preserved in working

memory even though the causal link has been disrupted (survival under occlusion) and situations in which visual indexes are reassigned (cessation of existence, as far as the early-medium visual system is concerned). For this proposal to work, a time threshold for keeping the same index in working memory would have to defined in the system, but the explanation only presupposes subjects' ability to track objects (know how); no propositional knowledge (know that) has to be involved. For these reasons, I do not take this move to be sound. In fact I do not take it as representative of the Incremental Strategy altogether.

On the other hand, Carey and Xu might be taking another line. SPELKE-OBJECT is part of a system of built-in generalizations about the behaviour of certain things in the world, corresponding to propositional knowledge about the persistence conditions of material objects.

As the experiments in Xu and Carey (1996) and Xu (1999) indicate, Spelke's *core systems* are the launch pad for the acquisition of more fine grained concepts, such as TOY TRUCK or BALL, in the case of the object representing system. As children mature, they start employing the specific concepts to individuate and identify the objects that fall under them. If this is on the right track, representing an object under SPELKE-OBJECT and representing it under more specific conceptual information, say, BALL, is not the same thing. The former could be a rudimentary form of demonstrative thinking, maybe even shared amongst other animals, whereas the latter is more sophisticated possibly depending on human linguistic practices. Note, however, that if the individuation and identity of material objects depends on specific conceptual information about kinds, no argument for SPELKE-OBJECT is provided. This move lies outside the scope of the Incremental Strategy for Sortalism, as it motivates the idea that fine grained type-level information plays a role in how objects are individuated and identified. In fact, such interpretation of Carey and Xu's line of reasoning corresponds to position (b) in section 4.1, which has been argued by David Wiggins (1967, 1980, 2001) over the years. Simply put, it states that spatiotemporal information - captured either under Pylyshyn's Natural Constraint or by Spelke's principles - has no privileged status in the individuation and (re) identification of objects. This in fact is the *Identity-over-Individuation Strategy* for Sortalism. Given its complexities, it is worth dedicating an entire subsection to it.

To sum up, it seems that the punch of the Incremental Strategy for Sortalism lies with the informationally promiscuous character displayed both by object-file representations and SPELKE OBJECT concepts. As the evidence gathered here is inconclusive, I shall reserve my final judgements for section 5. Beforehand, we must take a look at another option that the sortalist might take.

4.3 The Identity-over-Individuation Strategy

When the notion of qualitative identity was introduced, I mentioned at least two ways to cash it out. On the one hand, one could follow Strawson (1959) in taking the representation of spatiotemporal continuity as a minimal way of capturing the identity conditions of material objects. Although I have been concerned only with this conception of identity conditions, there is an alternative, non-minimal, rendition of the notion. Now is the time to introduce it. According to the counting argument and the argument from divided reference (section 2.2), visualizing an object could elicit different object-dependent mental representations. For example, by seeing a deck of cards the subject could think about *that specific deck* or *those specific cards*, depending on the sortal concept – DECK or CARD – that figures in her thought. The example suggests that information about *specific kinds* (i. e. type-level information) could bear on issues of numeric individuation. If the reasoning is sound, it motivates a *stronger* conception of identity conditions. Hence, it is worth distinguishing:

Weak identity conditions: Spatiotemporal information (captured under a suitable perceptual relation and SPELKE-OBJECT) is *sufficient* for the identification of the same medium-sized material object at different times.

Strong identity conditions: Spatiotemporal information (captured under a suitable perceptual relation) is *necessary* for the identification of the same medium-sized material object at different times.

The strong sense of identity conditions is usually motivated by cases of *radical metamorphosis*, in which a causal relation between a subject and an object is preserved during some time interval, but there is an event within the interval that changes how the subject cognitively discriminates the object. Here is an ordinary example. Ann is looking at her father, Peter, in his deathbed at t_1. After he dies, say, at t_2, Ann is still able to track the three-dimensional body that lies in front of her. Nothing has changed in terms of availability of spatiotemporal information. Yet, the individual that existed at t_1 (the person) is not the same as the individual that exists at t_2 (the body), even in the numeric sense! A more fanciful example found in the literature is the story of Lot's wife, who turned into a pillar of salt after looking back on Sodom. To this scenario, a similar explanation applies. Moreover, the strong notion of identity-conditions is also motivated by what can serve as objects of demonstrative thoughts. We not only think about specific medium-sized physical objects, but also about things that violate the alleged constraints on spatiotemporally continuous movement. For example, we can think demonstratively about specific sand dunes, mountains and waves, which are not 'stereotypical' material objects.

As the name suggests, the *Identity-over-Individuation* strategy has at its heart the idea that an object's identity conditions (in the strong sense) cannot be dissociated from or given independently from conditions on its individuation. According to Wiggins (1997: 417), identity conditions are characterized as specifying 'a particular way of behaving, coming to be, being, being qualified, and passing away' of a given object. Spatiotemporal continuity constitutes only one of such many *ways of being*. As fine grained information about the identity conditions of an object of a specific kind can only be provided by less general sortal concepts (e.g. PERSON, DOG, STAR, RIVER), we can fully appreciate how this strategy supports Sortalism (see Wiggins 1967, 1980, 1997, 2001, for a thorough defence).

The first difficulty that arises for this form strategy concerns which sortal captures the object's individuation and identification conditions (in the strong sense). For example, Felix, my pet cat, could be singled out as KITTEN, CAT, ANIMAL, CREATURE, etc… Would it be the case that as long as the subject has any of these in her conceptual repertoire, she is able to have demonstrative thoughts about Felix?

Members of the Identity-over-Individuation strategy, such as Wiggins, are inclined to say no, because the introduction of a more robust notion of identity conditions requires the specification of the totality of transformations that an entity of a given kind can undergo while still being the same entity. Otherwise, the distinction between specific sortals, like CAT, and more general concepts like MATERIAL or SPELKE OBJECT would be severely weakened. Wiggins (1967, 1980, 2001) claims that only one kind of sortal could do the job: *substance sortals*. For example, if Felix ceases to be a CAT, say, because it died, there is no individual left. Now, if Felix ceases to be a KITTEN as it matures, it still persists as the same individual. Substance sortals are distinct from *phase* sortals, such as, KITTEN, ADOLESCENT, CATERPILLAR, which specify a stage in the individual's life. Be that as it may, it all depends on how stringent the connection between substance sortals and the specification of the *totality* of transformations that an object of given kind can undergo is cashed out. Would it be the case that, when whales were classified as fish, people lacked the ability to have demonstrative thoughts about such aquatic yet mammalian creatures?

There is a second, more pressing, difficulty for the Identity-over-Individuation strategy. Consider a person who sees an aeroplane for the first time, as it lands. It seems natural to suppose that the subject would be able to single out the aeroplane in her mind and to track it as it approaches the ground even though she lacks any form of conceptual, type-level, representation about planes. Specifically for our purposes here, how would Wiggins explain the data reviewed in previous sections of this paper (sections 3 and 4.2)? It seems that a distinction between demonstrative thoughts involving specific sortal concepts (say, demonstrative thought proper, according to this variety of Sortalism) and more primitive forms of thinking has to

be drawn.

Wiggins attempts to answer both issues by a particular view on conceptual change. While reserving the notion of *concept* solely for the determination of proposition constituents in a Fregean, mind-independent way, Wiggins defines a conception *f* of an individual x as 'a set of beliefs concerning what *x*s are'. What groups x under a conception of *f* is the fact that, given a good exemplar of that kind, *f* would be the best theoretical description available. This suggests that '[t]here is room for the one and same concept of what it is to be an *f*, anchored as it is to examples that are grouped together in virtue of resemblances that are nomologically grounded, to be unfolded gradually in a succession of different and improving conceptions' (Wiggins 2001, 82). The distinction between concepts and conceptions is also helpful in solving a tension within what concepts are taken to be. For example, on the one hand, the concept CAT constitutes my belief *that Felix is a cat*, but, on the other, my concept(ion) CAT is defined in terms of what I believe of cats. At this point, I am not going to re-frame previous sections in terms of the concept/conception distinction. Rather, I will just assume that my use of concepts could potentially cover the two distinct roles[11] (see Woodfield 1991, for the concept/conceptions distinction).

The remarks above carry some interesting consequences. Although the identity conditions of a given object are captured by a sortal concept (in Wiggins' sense of the term), our *grasp* of such conditions is achieved via a particular *conception*. Thus, the body of information that we use in deciding the ways objects come to be, pass by, and cease to be, is in constant revision. As identity governs individuation, the same point carries over to the latter notion. Now, let us see how this apparatus caries over to the difficult cases.

When the aeroplane was seen by the first time, the subject forms of a conception *f*, which is the best theoretical description available to the subject. Maybe *f* could be spelled out as *flying human operated artefact.* However, this is highly cultural dependent. Why not *metalic dragon*? Which of these conceptions would bear the correct relation to the corresponding concept? It seems that in order 'for a thinker to single out or individuate a substance, there needs to be something ...about his rapport with x or his relational state towards x and his practical sensibility in relation to x, which ... sufficiently approximates to this: the thinker's singling x out as x and as a thing of a kind *f* such that membership in *f* entails some correct answer to the question, "what is x?" ' (Wiggins 2001, 7). There are two

[11]SPELKE OBJECT, for example, shows a similar duality. According to the Sortalist, it is necessary for thoughts of the form 'that [SPELKE-OBJECT] is to the left', where the concept in square brackets works as a silent restrictor, but it also is a part of a system of core knowledge concerning the behaviour of material objects in the environment.

possibilities here. Either there is a unique answer to the question or there are many. In the first case, the conception *f* would have to be the psychological embodiment of the actual kind (e.g. balls, chairs, dogs, stars). Since the actual kinds (substances) could always be hidden from us, we might not be able to have singular thoughts about certain things at all. This seems to be too strong. In the second case, many concepts are good enough for the purposes of demonstrative thinking, depending on the subjects 'rapport', 'relational state' and 'practical sensibility' towards the object *x*. But if having a good enough concept is a matter of degree, how could sortals play the normative role of capturing individuation and identification conditions of objects *tout court*?[12] Would a SPLEKE-OBJECT concept be good enough? Taking the distinction between the Incremental and the Identity-over-Individuation strategies for Sortalism for granted, one has to say no. But what in Wiggins' theory predicts such negative answer? Nothing, apparently.

With regards to the data that motivated visual indexes and object files (sect. 3), Wiggins could simply invoke the distinction between metal states required for the purposes of simple actions and demonstrative thought proper. The latter emerging from a conception *f* that constantly evolves as the subject's state of knowledge improves over time. Although the point is well taken, there is another sense of 'evolving' that is missed. As mentioned previously (sect. 3 and 4.2), visual indexes and object-files are initial stages of an 'evolving' process of object representation. Recognising an individual as the winner of 2007 air guitar championship as *that man* draws both from world knowledge and bottom-up visual processes. Now, if we recognize the role that such early-processes play on individuation and identification, whichever higher-order (possibly concept-involving) processes that kick in afterwards build on already object-dependent representations. In Wiggins' words, the recognition of a subject's 'rapport', 'relational state' and 'practical sensibility' towards the object *x* is a good step in understanding how visual experience involves, at least partially, conceptual content, but it also seems to equip the subject with the means to individuate and identify objects without the apparatus sortal concepts.

To sum up, I offered two reasons why sortal concepts concerning specific kinds (CAT, PERSON, MOUNTAIN, STAR) are not necessary for individuating and identifying medium sized objects. First, if they were, a strong criterion for determining what the sortal concept must be like in order to play its role. Such criterion, however, cannot be provided. Therefore, sortal concepts(ions) cannot play the strong normative role they allegedly play. Second, if sortals are framed in any sort of incremental picture of visual processing and the evidence provided in

[12] Similar doubts have been raised by John Campbell. He (2002, 72-3) considers a subject could looking at a plastic plant in a garden and think 'That plant is pretty!'. Here, the use of the wrong sortal PLANT does not seem to preclude the subject with the ability to single out the right object.

section 3 is properly recognized, it follows that sortals depend on indexes and object-files. Thus, individuating and identifying an object would already been achieved at a previous level in processing.

5 The Return of the Relational View

5.1 The Debate Re-stated

My argument against both varieties of sortalism, the Incremental strategy (section 4.2) and the Identity-over-Individuation strategy (section 4.3) is roughly the same. Once the incremental nature of visual processing is recognized and the object-dependence of certain mental states is recognized, Sortalism seems to be unmotivated. The full specification of the argument draws on a bigger picture of the Singularism vs. Descriptivism debate and the evidence reviewed in section 3, will I will provide now.

5.2 Why Not Sortal Concepts

At the beginning of the paper, I mentioned in passing (section 1, footnote 3) an argument that *Bare Singularists*, who believe that object-dependence can only be accounted for in terms bare object-token representations, level against *Descriptive Singularists*, who believe that mainly descriptive representations (concepts, visual features) can also capture object-dependence. Roughly, the idea is that as soon as the claim that the individuation and identification of particular objects is achieved by the instantiation of a set of properties is made, the distinction between singular and general thoughts is weakened. This is counter-intuitive, because the distinction between the two kinds of thoughts manifests itself as different patterns of behaviour, which need to be accounted for. How then would the Descriptive Singularist block the argument?

First, some stage-setting is necessary. I take both forms of Sortalism, the Incremental Strategy (section 4.2) as well as the Identity-over-Individuation strategy (section 4.3), to be incarnations of *Descriptive Singularism*. This is so because both the notion of a SPELKE-OBJECT and the notion of an evolving conception *f* of an object x roughly correspond to clusters of descriptive information, which vary according the form of Sortalism taken. For example, SPELKE-CONCEPT could be paraphrased as a conjunction of concepts, such as (BOUND ^ SOLID ^ MOVES IN A CONTINOUS PATH ^ NOT SELF-PROPELLED), and an evolving conception *f* of, say, *bachelors* necessarily involves the properties of being male and single. The question then is how the Sortalists would account for object-dependence?

It seems that representing *location* is the most prominent candidate. This naturally fits the claim that sortals are *necessary*, but not *sufficient*, for the individuation and identification of objects. As Sortalism must appeal to causal relations at a certain point in order to fully characterize demonstrative thoughts, an object's location at a time could be the missing piece that conveys where in the environment instantiators of sortal concepts are found. Note that this move is not exclusive to the Sortalist and it is also made by people who take objects as clusters of (possibly nonconceptual) features bundled by the coding of location (see Campbell 2002, Clark 2004). The individuation and identification of a ball, for instance, located at *l* at *t* is paraphrased, according to the Incremental strategy, as SPELKE-OBJECT occurring at *l* at *t* and, according to the Identity-over-Individuation strategy, as BALL occurring at *l* at *t*. Multiple objects are represented by the representation of multiple locations at a time. Tracking a single object involves the recognition of its persistence conditions, specified by either SPELKE-OBJECT or a more specific sortal, that would trigger shifts of attention towards the expected place or direction.

The problem of this move is that it simply does not predict the data reviewed in section 3. A Sortalist model of shifts of attention does not predict the *parallel* form of processing that seems to be involved in subitizing (section 3.3) and multiple object tracking (section 3.4) More importantly, even if a sortalist model could be amended to cover that, it cannot account for subject's success in tracking *co-located* objects. The importance of the Blaser et al. (2000) study is that it clearly shows that subjects can track objects moving through feature-space (recall the gabors mentioned at section 3.4), putting forward a notion of bare-object representation prior to the experience of locations. Finally, the dual role of information derived from an object, i. e. bringing about certain object dependent representations *vs.* encoding the object's visual properties, simply is not recognized in the sortalist model (see my comments on informational distribution in section 3.6). This might have undesirable consequences[13].

Now, the sortalist could not only recognize the data reviewed in section 3, but also the theory that explains it. This move is at the heart of the Incremental strategy for Sortalism, since it takes that the early stages in visual processing culminates at a level of representation structured by sortal concepts (i.e. demonstrative thought proper according to the sortalist). Carey and Xu's (2001) seem to take SPELKE-CONCEPT as defining such level, but as the experiment in Xu and Carey (1996) and Xu (1999) as well as my take on a possible take on Wiggin's notion of a evolving conception *f* (see my final comments at section 4.3), suggest that such level might be defined by more specific sortal concepts, such as BALL, as long as

[13]One of which would be an account of immunity to error through misidentification of demonstrative thoughts, spelling how this would work, however, falls outside this paper.

they are available to the subject.

Now, acknowledging a mechanism of primitive object representation brings problems through the sortalist's back door. If one accepts that visual indexes and object-files explain the object-dependence data reviewed in section 3 and given that object-dependence is nothing but the cognitive individuation and identity (in the weak sense) of objects, then one must accept that individuation and identity are represented at a level of mental processing that is not structured by sortal concepts. In sum, the Sortalist would be giving up its underpinning claims, namely:

Sortal Individuation: Cognitively individuating a specific object requires the apparatus of sortal concepts.

Sortal Identity: Recognizing the conditions under which objects remain the same requires the apparatus of sortal concepts.

Now, I have mention that the notion of identity in the statement above is the weak one, defined in terms of spatiotemporal continuity (SPELKE-OBJECT plus the coding of location at a time). Of course, the early-medium visual system is incapable of representing information concerning the transformations that an object of a certain kind may undergo, that is, identity in the strong sense. So the question now is the following. Could it be possible for Sortalism to play a role in capturing objects' identity in the strong sense?

5.4 The Right Division of Labour

The short answer is no, but let us try to make the sortalist's case as strong as possible to see why it is not appealing. The move would be advocated by the strong variety of Sortalism (i.e. the Identity-over-Individuation strategy). Its punch line is the following. One could recognize the data concerning the bare object processing bias showed in section 3, but additionally one could also recognize a bias towards specific type-level information under which objects fall. There is some intuitiveness to the idea. After all, in order to recognize Felix, my favourite cat, the information that if falls under CAT seems to play a more important role than representing that facts that it falls under HAS WHISKERS or GRAY. The former, but not the latter, would be the most natural answer to the question 'What is Felix?'. This also connects with the way we naturally represent situations and events. If there were a bias towards a specific concept rather than others (CAT vs. HAS WHISKERS, for instance), then this information could be useful in providing a basic frame against which we could evaluate the unfolding of events or situations. Identifying Felix as a cat would inform the agent that he is in a cat-involving

situation and that possible outcomes concerning cats are constrained by one's beliefs about the kind of transformations cats can undergo.

Although this seems to be a nice line to pursue, insofar one can find evidence for a *type* processing bias can be found, it does not support Sortalism. As mentioned many times throughout the paper, Sortalism is a thesis about the Individuation and Identification of objects. If it does not achieve that, it does not play the theoretical role it plays. To see that, one has only to run the story mentioned above without sortal concepts. By having a visual experience of water, the agent could more easily retrieve the concept WATER and use that in figuring out that he is in a water-involving situation. This would, of course, support some form of *Conceptualism*, but not *Sortalism*.

6 Conclusion

In section 1, I have presented the debate between two traditions within Philosophy of Mind and Cognitive Science about the nature of demonstrative thinking: Bare Singularism and Descriptive Singularism, which I took to be supported, respectively, by the Relational View and Sortalism. After introducing these positions in section 1 and 2, I have reviewed experimental data in their support. Section 3 motivated a mechanism of object individuation based entirely on causally transmitted information and constraints imposed by the visual system (in favour of the Relational View). Section 4 dealt with two varieties of Sortalism: one motivated by empirical findings (the Incremental Strategy), another by conceptual reasons (the Identity-over-Individuation Strategy). In section 5, I have offered some arguments in support of the Relational View. Sortalism does not seem to explain the data concerning object-dependence reviewed in section 3, and the most plausible way to account for that – i.e. the postulation visual indexes and object files – makes sortalism theoretically inert. Towards the end of section 5, I played with the possibility of a process bias towards certain concepts under which the objects fall. Thus, the identification of certain kinds would be more basic than other and this could set up a basic representation of the possible outcomes of events containing objects of that kind. This move however, would not support Sortalism, but conceptualism more generally.

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