



How to Derive Aristotle's Categories from First Principles

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Abstract

We propose a model of cognition grounded in ancient Greek philosophy which encompasses Aristotle's categories. Taking for First Principles the brute facts of the mental actions of separation, aggregation and ordering, we derive Aristotle's categories as follows. First, Separation lets us see single entities, giving the simple concept of an individual. Next, Aggregation lets us see instances of some kind, giving the basic concept of a particular. Then, Ordering lets us see both wholes-with-parts as well as parts-of-some-whole, giving the subtle concept of a relational or Gestalt. The basic and the subtle concept give us the major and minor categories. The categories constitute a top-level ontology and describe universal usage so that any other category necessarily describes particular or domain usage.

Keywords Aristotle · Categories · Cognition · Concepts · Gestalts · Perspectives

1 Introduction

Aristotle presented the categories at *Cat* 4 as a list of aspects of things, of different things that can be said, or of something being “either substance or quantity or qualification or a relative or where or when or being-in-a-position or having or doing or being-affected”.¹ Unfortunately, he did not say how he arrived at these categories, a problem that, to this day, has not been resolved. What makes the problem all the more compelling is that the *Categories* is placed first in the corpus implying that it was deemed to be of foremost importance for students. However, even more weight

¹ References to Aristotle are given as *XX* aabcc or *XX* d.ff, where *XX* is the abbreviation of the work as per (Shields 2015, p xix) and *aabcc* are the Bekker pages and *d.ff* are the book and chapter. All references are to Barnes (1995b).

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must be given to the fact that it is unlike Aristotle to present something as important to his thinking as the categories as summarily as in *Cat* 4. Indeed, one would have expected a proper review of the opinions of his predecessors and why they were wrong. Nevertheless, whether it is just a working draft, lecture note, student note or even inserted by a later editor (and because we cannot ask Aristotle for clarification), it stands to reason that if there is anywhere a need to be charitable it is here. As Seneca wrote “the ancients must be listened to, indulgently. Nothing is completed while it is beginning” (1972, VI, 5.3). Note however, that by this quote we do not mean to say that we have the answer; in fact, we believe the question is moot. Also, not only is the question moot, it is not even the question we address. The question we *do* attempt to answer is how the categories *can* be constructed.

Given that to the best of our knowledge, nobody has tried to do this before, we can skip the review-and-why-they-were-wrong part and proceed to explain how to do it. So, rather than giving yet another textual analysis of the *Categories* we approach the categories from a different angle. Putting ourselves in the role of the diligent student, we note Aristotle’s opening of the *Physics* “[...] we do not think that we know a thing until we are acquainted with its primary conditions or first principles” (184a13–4) and so we take Aristotle literally, accept the list as it stands and ask ourselves what his starting point, i.e. the origin of the categories, could have been. In answer, we turn to his ‘dictionary’ in the *Metaphysics* where we find that “we must sometimes begin to learn not from the first point and origin of the thing, but from the point from which we should learn most easily” (1013a1–2). What this tells us is that it is permissible to make use of resources developed since Aristotle. Thus, we note the progress made in the sciences and, in particular, the finding that different creatures tend to be cognizant of their environment to different degrees. What this allows us to assume is that cognition in itself is a universal property of life. Accordingly, we take as our working hypothesis that ‘cognition’ is the origin of the categories. Next, we note that the opening line of the section “We call an origin” (1012b33) has a footnote which says “‘Origin’ translates ‘ἀρχή’, elsewhere often ‘source’ or ‘(first) principle’” (sic). Thus, we assume that ‘cognition’ is the First Principle, but then we read at 1013a16–17 that Aristotle thinks of ‘origins’ as also being ‘causes’, which he elaborates as “Therefore the nature of a thing is an origin, and so are the elements of a thing, and thought and choice, and substance, and that for the sake of which” (1013a19–21). That looks promising, because a causal explanation is clearly to be preferred over just grouping the categories and simply labelling them, though “the nature of a thing” is not much help, because we cannot say that we actually know the ‘nature of Cognition’. Fortunately, we recognize in the other four items Aristotle’s Four Causes (which we must leave unexplained here, but will return to later). Going back to the dictionary we find at 1013a24–34 that ‘causes’ have *four* elements which, in the above quote, are: formal “the elements of a thing”, efficient “thought and choice”, material “substance”, and final “that for the sake of which”, respectively. The placing of the commas in the text indicates that “thought and choice” are ‘one of a kind’ and their opposition further raises the question of what their essential difference might be, but “choice” is the more appealing one, so we put that difference aside for the moment. The elements that interest us, then, are “choice” and “that for the sake of which”, because the former is what

has an effect and the latter is what motivates us to make a choice in the first place. This gives us the ‘how’ and the ‘why’ of Cognition, albeit that only the ‘how’ seems relevant to our undertaking. Consequently, we rethink our working hypothesis to say that Choice is the First Principle of the categories.

At this point, note that the benefit of taking the approach described above is that this allows us to bypass 23 centuries of argumentation, because we only need to show that the categories follow logically from taking Choice as the causative element of Cognition. The model we offer is an inference to the best explanation and the scope of this paper, then, is strictly limited to showing how this model encompasses Aristotle’s categories. Hence, these categories will be treated as given and consequently as being without need for discussion. Likewise, criticism of the categories themselves will be deemed out of order and neither discussion of alternatives to, nor previous explanations for, the categories will be covered.

Our next step is to assume that there is some structure to Aristotle’s categories because of, firstly, Aristotle’s distinction between primary and secondary substances, secondly, his difference in treatment between the major and minor categories and, thirdly, his description of time and place as continuous quantities at *Cat* 4b25. This last is corroborated by Simplicius (2000) who reports Porphyry and Iamblichus as saying that the minor categories supervene on the major categories (297, 24–27). Following that, we assume that this structure can be derived from the Principle of Choice as mentioned above, but for that we first need to decide on what we believe the categories are *for*. This we have not been able to find in Aristotle’s corpus, so we turn to the commentators for enlightenment or, rather, we turn to a review of a critical period in their debate. Christos Evangeliou (1996) reports that the debate about how to interpret *Cat* 4 has a long history, but that starting with Porphyry in the third century a consensus was reached, which later became known as “the standard interpretation” (p. 27). He comments that this interpretation held that (quoting Iamblichus) “It is Aristotle’s purpose here to deal neither with vocal signs only nor with concepts only, nor with existing things only, but with all the three together” (p. 32) and further that “The same history was repeated in modern times [with] authors of recent books and essays [...] favoring an inclusive interpretation of one sort or another” (p. 33n31). On the other hand, Amie Thomasson (2019) reports, after (briefly) reviewing contemporary category systems, that skepticism about ontologically ‘highest genera’ has shifted to a discussion of merely articulating distinctions among our conceptual or linguistic categories. The conclusion we feel justified in drawing here is that our approach of taking Aristotle literally (as far as that can be done, working from translations) is the right one. Consequently, we accept “things that are said” at *Cat* 1a16 as our key term. (Strictly speaking, the categories also pertain to “things that are thought”, but we will ignore that since the distinction is immaterial to our model.) This allows us to narrow down the ‘nature of cognition’ to ‘knowing as experienced by the individual’ and then further gives us a roughly linguistic perspective, though one which we will have cause to refine later on.

The model to be presented will be a conceptual structure, grounded in ancient Greek philosophy. The structure will have four levels which will be referred to as ‘concepts’. The problem here is unfortunately that there is as yet no consensus on what concepts actually are (c.f. Margolis and Laurence 2014) and so, mindful of

Pólya's (1957, p. 90) advice that we need to choose a definition that "fits the case", we stipulate 'concepts' to be 'mental representations with categories as their constituents'. We start then with considering 'substance' to be a complex notion which we disassemble by using the method reported by Plato in the *Phaedrus* at (265E1-2) of cutting along what can be called its 'natural joints'.² The first cut goes between what does and does not belong, the second cut goes between what is necessary and what is contingent and the third one goes between what can be observed and what needs to be imagined. The procedure can be visualized by imagining 'substance' as a cube and cutting through its faces giving us $1 + 2 + 4 + 8 = 15$ elements which will be the categories. These categories we find in the treatise as, respectively, (1) "things that are said" at *Cat* 1a16, (2) "names" at *Cat* 1 and "primary substances" at *Cat* 2a13-15, the ten categories of *Cat* 4 in two groups as follows (4) the major categories (*Cat* 5-8) and (8) the six minor categories plus two 'missing' categories. These latter will later be identified as 'matter' and 'process' and argued to be the two complementary ways of viewing the 'substance' of a Gestalt, a whole that is greater (or other) than its parts (this will be elaborated later). That these two categories are missing from Aristotle's corpus should be no surprise as the notion of Gestalt only emerged in psychology in the early twentieth century and the current notions of matter and process are relatively modern concepts. (And while there are ample mentions of 'matter' throughout the corpus, it remains to be seen whether his understanding of the notion is the same as ours.)

Our justification for presenting this model is that "Aristotle's *Categories* is a singularly important work of philosophy" (Studtmann 2021) and that the categories themselves are "perhaps the single most heavily discussed of all Aristotelian notion" albeit with no consensus on how they are to be understood (Smith 1995 p. 55). Our aim, then, is to offset the skepticism mentioned by Amie Thomasson (2019) above so as to refocus the discussion on categories in general and to rekindle the interest in Aristotle's categories in particular.

Lastly, a caveat. This paper aims to be accessible to both philosophers and non-philosophers alike and is therefore purposely philosophically naïve, mindful of Porphyry's claim that Aristotle "wrote the *Categories* as an elementary work for beginning students, while the *Metaphysics* was written for advanced students" (1992, *In Cat* 134, 8-9 and c.f. Ammonius 1991, 36, 12 and Dexippus 1990, 40, 22-23). To be sure, one may have expected a more extensive treatment, but we are presenting a paper and not a book. Note also that the philosophically wise reader is expected to be charitable.

2 Establishing Common Ground

This paper builds on (and corrects) work done by the first author in (van Polanen Petel 2003) and two ensuing publications (2006, 2007).

² References to Plato are standardly given as XXX aaBcc, where XXX is the work and aaBcc are the Stephanus numbers. All references are to Cooper (1997).

2.1 The Domain of Application of the Categories

Categories can be thought of as rubrics for sorting anything whatsoever, serving to classify both real and imaginary denotata yet having existential import only for the world in which they apply. Thus, ‘flying horses’ will only classify ‘Pegasus’ in the world of Greek mythology and a ‘square circle’ is only likely to be found in a Lewis Carroll-like world. This distinction between ‘real’ and ‘imaginary’ is important and it is as well to say this upfront. Essentially, our experience of reality is *layered* in the sense of our interpretations overlaying our impressions, separating the world as it appears to us from the world as it is. But the word only appears different insofar as how we *think* the world is and that means that while knowledge collapses the two worlds, it is our opinions that keep them apart. Greek mythology is then like an opinion and constitutes a world *as-thought* and the world of Greek mythology is then a world *as-appears*. In addition, there can be stories within stories within stories, as in the stories popularly known as the “Arabian Nights”, resulting in multiple worlds stacked on top of each other. At each layer there is an ‘above’ and a ‘below’ where the world above functions as the world *as-thought* and the one below as the world *as-appears*. At the top is then a world *as-thought*, at the bottom is the world *as-is* and in between all the worlds are *as-thought* or *as-appears* depending on whether they are seen from below or above. Note then that the model we will be presenting has no viewpoint but pertains to each level equally.

Now, ignoring for the moment imaginary worlds as well as illusions, misperceptions, hallucinations and the like, we presume our perceptions to be veridical and thereby conflate the world *as-appears* with the world *as-is*. In other words, we presume our categories to *legitimately* classify denotata. The distinction is then between how the world *is* and how it is *thought to be*. The metaphysical grounding is the tri-partition mental-formal-physical, or intelligible-logical-sensible, as recognized in various forms since at least the ancient Greeks. Plato in the *Sophist*, recognized belief, speech and that which speech is about (261C3-262E6); Aristotle, in the *Metaphysics*, treated the Principle of Non-contradiction as (a) psychological “it is impossible for any one to believe the same thing to be and not to be” (1005b24-25), (b) formal “contradictory statements are not at the same time true” (1011b13-14) and (c) ontological “the same attribute cannot at the same time belong and not belong to the same subject in the same respect” (1005b19-20).³ In modern times, Peirce (1908) proposed the notions of types, tokens and marks while Ogden and Richards (1923) proposed the popular semantic triangle distinguishing between thought, sentence and referent. Other examples could be given, but the point is that these are basically all variations on the same idea. Simplifying, we conceive of reality (as experienced by the individual) as having an ‘outside’ and an ‘inside’ with an interface between the two. Borrowing Quine’s notion of ‘quality space’ (1960, p 83–84), we conceive of this interface as an ‘awareness space’ that serves as the

³ There is another, brief mention in the dictionary, Book 5 of the *Metaphysics*, “the first point from which a thing either is or comes to be or is known” (1013a17); this, too, suggests a tri-partition, but would require further study to be substantiated.

connection between ‘inside’ and ‘outside’. However, utilizing the Stoic distinction between *phantasma* and *phantasia* (Diogenes Laertius 2000, VII.49) we not only become aware of things as presented by our senses (*sensibilia*), but also as projected by our mind (*intelligibilia*). Accordingly, it will be convenient to refer to the content of the awareness space both as a ‘percept’, as in ‘outcome of a process of perception’, as well as a ‘concept’, as in ‘outcome of a process of conception’. Recall here our mention in the *Introduction* that Aristotle thinks of ‘origins’ as also being ‘causes’ and, in particular, his analysis of the ‘efficient’ element into “thought and choice”. We can now give an answer to the question of the difference between these as follows. We provisionally define ‘thought’ as ‘process of conception’ and ‘choice’ as ‘process of perception’ (though, as already commented in the *Introduction*, the distinction is immaterial to our model). Both percept and concept are representations, but with no essential difference bar one of direction: the percept is directed *inward* while the concept is (ultimately) directed *outward*. Outside, then, is the *physical* world where we seek the ontics of some representation, inside is the *mental* world where we determine the meaning of that representation and at the interface between outside and inside is the *formal* world where we locate the representation itself, that is, the world *as-is*, the world *as-thought* and the world *as-represented*, respectively. The only presumption required is that there is a world (real or imaginary) where the referent exists or, in a pragmatic sense, can be found. Note that this presumption must be true in fact for the real world, but for an imaginary world can be true by fiat, i.e. when we place our trust in authority rather than experience. Indeed, the world *as-thought* can be counterfactual as long as believing in it does not upset the priorities of daily living (which is perfectly feasible, because those priorities of daily living virtually ensure that the central part of the world *as-thought* constitutes an adequate map of reality; after all, most of us tend to function acceptably well on a daily basis).⁴ What this means is that while the awareness space does serve to connect ‘inside’ with ‘outside’ this provides no warrant to assume all our perceptions to be veridical (but more on this later). The consequence of this is that the content of the awareness space can be grounded only on the proviso that the world *as-thought* does in fact correspond to the world *as-is* for the item concerned, because “ultimately there must be some exit from the maze of words” (Pears 1951, p. 53) and “the edge of the [belief] system must be kept squared with experience” (Quine 1951, p. 42). However, Pears also said that this exit need not be made (*ibid*, p. 227), but that would only be true under conditions of fiat. Likewise, we could exit from the maze into another (embedding) maze, but the same conditions of fiat would then still apply.

A note of caution is in order here. Our model of reality is strictly from the perspective of, and as experienced by, the individual. Thus, it essentially portrays an *instance* of some awareness and is therefore more in agreement with Ogden and Richards’ (1923) semantic triangle, i.e. referent, thought and sentence, than with Karl Popper’s (1973) three ‘worlds’, i.e. the physical world, the mental world and

⁴ For impossible objects, imagine this scene at the Mad Hatter’s tea party. “Look,” said the Mad Hatter as he lifted the lid off the teapot and much to Alice’s surprise, there it was: a perfectly square circle.

the “world of objective contents of thoughts” (p. 106). Where Popper’s worlds comprise all, our world *as-is* consists of only Ogden & Richards’ ‘referent’, our world *as-thought* consists of only their ‘thought’ and our world *as-represented* consists of only their ‘sentence’, but each within the (larger) context of Popper’s three respective worlds.

The conclusion we have reached now is that, since we have accepted Aristotle’s “things that are said” as our key term, we must concern ourselves with only the *formal* world, because that is where we locate those “things that are said”. Indeed, it is only in the world *as-represented* that we find sentences that we need to find referents for and that we need to determine the meaning of. Consequently, it is the world *as-represented* which is the domain within which the categories have application and we have presented our model of reality for the specific reason of where to locate this domain.

2.2 The Nature of the Awareness Space

The awareness space is where our senses present their output. Thus, from outside we get the sensibilia, i.e. images, sounds, smells, tastes and tactile experiences as well as feelings (because our body is ‘outside’ our mind and, no doubt, ‘feelings’ can be diversified, but we lump that all together for convenience). What we get from inside are intelligibilia, i.e. memories of sensibilia as well as theories we have learned or constructed in our mind. Note that whatever is in the awareness space needs not to be verbal, because we can ‘say’ things non-verbally. As a consequence, we need to rephrase “things that are said” as “things that are *signalled*”.

Following (van Polanen Petel 2006), we note that regardless of the mode of representation, anything that is signalled can, in principle, be expressed in words so that the content of the awareness space is effectively a (possibly one-word) sentence. Given that speech is an essentially linear mode, this means that sentence constituents can have only three possible types, i.e. having (1) *no* relation, (2) *one* relation (either direction) and (3) *two* relations (both directions). These can be called, respectively, Identifier, Modifier and Connective. Interpreting this typology as a grammar, it would be context-free and strongly generative (in the sense of Chomsky 1964, p. 53n), because it is logically possible to parse *any and all* possible sentences into these types. The significance of this is that, given adequate definitions, all languages are, in principle, mutually transformable, which we argue as follows.

Firstly, to substantiate the qualifier “given adequate definitions”, imagine interlocutors *A* and *B* having an argument about something. *A* informs *B* of some novel premise regarding that something which *B* rejects as mere *opinion*. *A* then shows the premise to be neither faulty nor leading to a contradiction and claims that this means that *B* must accept it as *knowledge*. It might be suggested that *B* could now propose to ‘agree to disagree’, as in the flawed world of human discourse often happens, but that must be resisted. On matters of knowledge, two people cannot rationally ‘agree to disagree’, because knowledge of the world is part of Common Knowledge which has, from a Bayesian perspective, been shown to be both consistent (Aumann 1976) and knowable (Aaronson 2005). The idea is that people

build up Common Knowledge by sharing their beliefs about what they hold as truths either overtly by providing information or covertly by not contradicting information provided by others. Thus, when *A* has shown the novel premise to be consistent with Common Knowledge, *B* is forced to accept the novel premise or stand accused of acting irrationally. More precisely, *A* and *B* can only ‘agree to disagree’ insofar as they refuse to discuss the basis of their beliefs (Hanson 2006). Given that *A*’s premise is neither faulty nor leads to a contradiction, such a debate would effectively force *B* to concede a contradiction in his belief system. Thus, while how the world is *thought* to be can be a matter of opinion, how the world *is* can only be a matter of knowledge. The implication is that the world *as-thought* is constrained by the world *as-is* and speakers obey this constraint on pain of being accused of speaking inconsistently (when their world *as-thought* is in error) or falsely (when it is imaginary).

Secondly, recall our qualification of “given adequate definitions” and substitute ‘definition’ for ‘premise’. Clearly, the same argument will hold so that all languages are, in fact, mutually transformable (of course, given sufficient resources, which was the force of the other qualifier, “in principle”). Using the more formal ‘symbol systems’ for ‘languages’, an example of this transformability is as follows. Given some problem in logic, a proof can be rendered in a variety of symbol systems, not all of which are linguistic. There are graphical systems, such as Frege’s *Begriffsschrift* (1879) and Peirce’s existential graphs (1906) and systems using a mathematics-like notation. These others organize their proofs in a variety of ways, some with a clear visual component, such as Beth (1959 pp. 67–70) who uses tableaux and Gentzen (1935) who uses a schema-like presentation for his system of natural deduction and his Sequent Calculus. Lastly, there are the more language-like systems, such as Łukasiewicz’s Polish notation (1929) and Lemmon’s (1965) style of Gentzen’s system of natural deduction. Since these symbol systems are all interchangeable and since natural language expressions can all be converted to expressions in logic it follows that all languages are interchangeable, notwithstanding the impracticality of some conversions.

What we have then, are three ways in which the content of the awareness space can be meaningless, but for it to provide a warrant that our perceptions are veridical a fourth condition must be satisfied. Consider, meaninglessness obtains (a) when the content of the awareness space fails to correspond with the world *as-is*, i.e. there is no referent, (b) when it does not cohere with the world *as-thought*, i.e. its meaning causes a contradiction or (c) when it is not well-formed in terms of the language of the world *as-is*, i.e. its meaning in the world *as-represented* is null. The first two reflect Leśniewski’s logical criteria for valid definitions, i.e. non-eliminability and non-creativity (e.g. Suppes 1957, p. 153n), the third reflects Church’s notational requirement that sentences need to be well-formed (Church 1956, p. 49, §10). However, even when these three conditions are not met the content of the awareness space can still be experienced as meaningful by fiat as in, for example, the case where the referent is in some imaginary world, because it can be well-formed in terms of the language of that imaginary world. Therefore, for the experience of meaningfulness to provide a warrant that our perceptions are veridical, the condition of fiat must be excluded, i.e. trust must be placed in experience and not in authority.

2.3 Grounding the Categories

We view categories as abstractions and abstraction as a cognitive ability, intrinsic to life though differing quantitatively by species and qualitatively by individual. Relevant to this are two observations. Firstly, while to an infant the world *as-appears* might be what William James called a “blooming, buzzing confusion” (1890, p. 488), the world *as-is* actually is not chaotic. This suggests a relation of complementarity between the cognitive ability of the perceiver and the world *as-is* as in James Gibson’s (1977, 1986) notion of affordance. This notion holds that there are possibilities for action latent in the environment of the individual, regardless of whether the individual is actually aware of them, but always in relation to the capabilities of the individual. For example, a chair affords sitting down on, but only comfortably so if the height of the seat is compatible with the height of the knee. This complementarity is like the relation between an ecological niche and the animal that occupies it, conceptualizing ‘niche’ as a ‘set of affordances’ (Gibson 1986, p. 128). The conclusion must be then that abstraction as a process is compatible with the *structure* of the world and it is this compatibility which legitimizes the categories. Secondly, the difference in cognitive ability between species suggests that this cognitive ability is not peculiar to humans and the difference in linguistic ability between adults further suggests that this is also a skill that is learned. How much of this cognitive ability is innate and how much is learned is still debated and a question that lies beyond the scope of this paper, but it is evident that some of it must be innate, otherwise there could not arise any cognitive state whatsoever. Thus, if we consider again the chair mentioned above, it seems reasonable to assume that, for example, a feeling of tiredness will cause the individual to become aware of the opportunity to sit down. Hence, we submit that this innate quality which causes an occurrence of cognition need not be more than Aristotle’s appetite in its sense of ‘desire’ (DA 414b1; *Rhet* 1370a16-27).

Viewing abstraction as a process, its input would be whatever is attended to, be it inside, outside or in the awareness space on the interface between the two and *analyzing* this into recognizable components and *synthesizing* the relevant ones into a meaningful whole. Or alternatively and in terms of Bruner et al. (1956, p. 45–47), the process works by selecting those attributes that are deemed relevant and reconfiguring these to form a single attribute and producing its output in the awareness space. But where Bruner et al. make their principal distinction between disjunctive, conjunctive and relational concepts (p 41), we postulate the mental actions of, respectively, separation, aggregation and ordering as underlying those. Our choice of these particular mental actions is based on our observation of the remarkable parallels of mathematics and (classical) logic with Bruner et al. below.⁵

⁵ Our choice of using classical logic is following Leslie Tharp’s comment “The reasons for taking elementary logic as standard evidently have to do also with certain imprecise – but I think *vital* – criteria, such as the fact that it easily codifies many inferences of ordinary language and of informal mathematics, and the fact that stronger quantifiers can be fruitfully analyzed in set theory, a theory of *EL*.” (italics in original) (Tharp 1975, p. 17).

Bruner et al.:	disjunctive	– conjunctive	– relational
mathematics:	subtraction	– addition	– greater-than
logic:	or	– and	– if
our postulates:	separation	– aggregation	– ordering

These three mental actions we accept as brute facts and we submit that it is these three that constitute the cognitive ability that is abstraction and that it is in these three that Choice as the causative element of Cognition is grounded. After all, we choose this *or* that or this *and* that or this *if* that. Being brute facts, we will assume separation, aggregation and ordering to be principles. Firstly, then, the process of analysis can be explicated by the application of the principles of separation and aggregation, giving rise to the notions of difference and similarity. Note that these have been shown by Hollingworth (1913) to involve different criteria so that, for instance, ‘most similar’ is not equivalent to ‘least different’, a conclusion confirmed by Medin et al.’s (1990) review of the relevant literature. The implication is that the two principles of separation and aggregation are independent of each other. Secondly, the process of synthesis can be explicated by the application of the principle of ordering which asserts that some structure obtains (without making any assumptions about either the character of the structure or of the elements involved). The implication is that the principle of ordering is independent of both separation and aggregation. A proof of independence can then be given if, conform Bruner et al.’s distinction between disjunctive, conjunctive and relational, the three principles of separation, aggregation and ordering are allowed to be interpreted in terms of Propositional Logic as follows. Let separation be the connective OR, let aggregation be the connective AND and let ordering be the connective IF. Then the independence of the connectives was originally shown by Alessandro Padoa (1901) and subsequently given various proofs (e.g. Beth 1953; McKinsey 1935; Smiley 1962 and see van Heijenoort 1967, pp. 118–119). By analogy, the three principles of separation, aggregation and ordering are independent as well. Being independent, these three principles are *primitive* and as such will henceforth be capitalized.

2.4 The Model of Cognition

The model of cognition is constructed by the sequential application of the three Principles of Separation, Aggregation and Ordering analogous to Bruner et al.’s (op. cit.) disjunctive, conjunctive and relational. The result is a four-level hierarchical structure that serves as the template whereby we know things. By itself it provides no information, but maps onto the awareness space such that the ‘windows’ of the template locate the aspects pertinent to each level as follows. Level-0 is where the ineffable experience of becoming aware of phenomena as ‘something’ is located. The other levels are as follows. Level-1 has the categories of *denotation*, level-2 the categories of *definition* and level-3 the categories of *description*; we will refer to these as the *simple*, *basic* and *subtle* concepts, respectively.

There being four levels in the model, this means that there are four different ways to view something as follows.

1. As something we are aware of, i.e. something that appears to be,
2. As something we can denote (identify uniquely), i.e. something in relation to everything else,
3. As something we can define as being of some kind, i.e. something in relation to something else and
4. As something we can describe as being a relational located somewhere and/or somewhen, i.e. something in relation to its physical and/or temporal context.

The phrase ‘somewhere and/or somewhen’ requires special consideration. Firstly and obviously, anything can be described as being both somewhere and somewhen, but that would be missing the point that Where and When are in different groups of categories. The one group is {Doing, When, Being-in-a-position} the other is {Being-affected, Where, Having}. That these two groups differ is shown by the fact that an agent cannot be described as both ‘doing’ and ‘being-affected’ at the same time, because that would repudiate Aristotle’s earlier mentioned dictum that “contradictory statements are not at the same time true” (1011b13-14). Consider then Aristotle’s examples for Where: “in the lyceum, in the market-place” and for When: “yesterday, last-year”. The problem with these is that the former carry significance, but the latter do not. A proper contrast would be either “Agora, Athens, Greece” and “399 BCE” or “in the market-place” and “the day Socrates was indicted”. The former pair carry no significance, the latter do. Thus, we submit that ‘temporal context’ needs to be viewed here not as a point on a time-line, but as a background of current events like, for example, on the day ‘when Socrates told Theaetetus his thoughts were mere wind-eggs’ (Plato *Theaetetus* 210B7-8) Socrates needed to appear in court to hear Meletus’s indictment of corrupting the youths of Athens. Clearly, Plato’s mention of the indictment is intentional, insinuating that Meletus’s arguments are ‘not worth bringing up’. The effect is to place the *Theaetetus* in a greater scheme of events. The point is that while we can describe things in different ways depending on the factors we take into account, the crucial difference is still between space and time and that difference allows us to describe things from two essentially different perspectives.

Secondly, the use of ‘and/or’ indicates that we have a choice of not two but *three* different ways to view something, (1) as something located in space, (2) as something located in time and (3) as a relational or Gestalt, because the two perspectives of space and time together create a figure/ground ambiguity (notion due to Rubin 1915). The reason why that ambiguity might not be apparent is our perceptual set, our expectation of what is there to see or feel, hear, etc. (Leeper 1935), but once the ambiguity has been pointed out, or after some mental gymnastics, both perspectives will be obvious. The switching from one perspective to another is effectively a reframing of the situation such that the various context-dependent properties become (de)activated or (un)available (Barsalou 1982), allowing us to see something in relation to its physical and/or temporal context.

The model of cognition being a template means that it makes no assumptions about the nature of whatever is in the awareness space. The level-0 concept of ‘something’ is a *logical form* as in, for example, ‘__?’ and ‘__!’ (fill in the blanks), in other words, ‘something’ is a variable that needs to be bound. Importantly, it is by giving an *interpretation* to this ‘something’ that the categories have application. The immediate consequence of being a template is that the possibility of an alternative does not arise. Therefore, there can be no alternative to the categories and any purportedly better system needs to demonstrate a better structure while all other systems need some First Principle and will thereby be *subordinate* rather than alternative and will be subsumed.

The conclusion we can draw here is that the categories are in fact a *top-level* (or upper or foundational) ontology. The first consequence is that the categories are not categories of signifieds, but of *signification* and the second consequence is that the categories subsume all other ontologies as *domain* ontologies. The resulting distinction is between *principal* and *subsidiary* categories or between the categories of the template and those resulting from the interpretation. Therefore, the number of *principal* categories is strictly bound by the number of ‘windows’ of the template while the number of *subsidiary* categories is only bound by the imagination, albeit constrained by the principal categories. The meaning attributed to the ‘something’ constitutes the First Principle of whatever the ‘something’ is interpreted as. Accordingly, different interpretations of the ‘something’ amount to different First Principles and when that meaning is not clear, a systematic inquiry will typically start at the bottom by giving a description and abstracting from this a definition yielding ultimately the ability to confidently denote the ‘something’.

Recall now from the *Introduction* the standard interpretation reported by Christos Evangelou (1996, p. 32) as “It is Aristotle’s purpose here to deal neither with vocal signs only nor with concepts only, nor with existing things only, but with all the three together”. Clearly, this is not exactly a top-level ontology, but it is close to it and we feel it strengthens our belief that our insights are correct. Indeed, if one would insist on viewing the categories as an ontology of *names* it would need to be an ontology of the lexicon of the language of some speech community and that would make it a *domain* ontology. Likewise, would ontologies of concepts and existing things be *domain* ontologies.

2.5 The Categories as Top-Level Ontology

Our purpose here is to show how Aristotle’s categories and, in particular, his “things that are said”, can be understood as a top-level ontology. Summarizing our discussion in *The nature of the awareness space*, we argue that the content of the awareness space is a *sentence* and that, given adequate definitions, all languages are, in principle, interchangeable (and, please, remember the force of the qualifiers “given adequate definitions” and “in principle”). Given further, as argued in the previous section, that the categories are a top-level ontology and therefore not categories of signifieds, but of signification, we now refine our perspective from ‘roughly linguistic’ to ‘formal linguistic’ which we elaborate as follows. These ‘categories of

signification’ are to be understood as *linguistic types*, though not in the sense used by Joseph Greenberg (1966), but rather in the same way that computer languages have types. The argument is, generally, that a “type structure is a syntactic discipline for enforcing levels of abstraction” (Reynolds 1983 p. 513) and, more specifically, that “in typed languages the type system itself is often taken as the foundation of the design and the organizing principle in light of which every other aspect of the design is considered” (Pierce 2002 p. 10). Accordingly, the levels of the model of cognition must be understood as follows. The level-1 categories of denotation are *lexic* types that afford effecting reference, the level-2 the categories of definition are *syntactic* types that afford building expressions, and the level-3 the categories of description are *semantic* types that afford building meanings. Thus, if “things that are said” refers to a sentence then the various constituents of that sentence need to form a coherent whole in the sense of obeying Church’s notational requirement of being well-formed mentioned earlier. However, further elaboration would be a separate project and falls well outside the scope of this paper. (For details see anon, van Polanen Petel 2006 for a preliminary study.)

2.6 The steps in creating the model

Separation, Aggregation and Ordering can be understood as generating the bases that allow us to choose which individual to denote, how to define some particular and how to describe some relational or Gestalt, hence the Principle of Choice. They can be understood as asking ‘who’, ‘what’ and ‘why’, respectively.⁶ Applying Separation asserts that we know things by being able to *name* them, applying Aggregation asserts that we know things by being able to recognize their *kind* and applying Ordering asserts that we know things by being able to understand them as a relational or *Gestalt* in the sense of being aware of their *circumstances*, both internal and external. The first part needs no introduction; the last two are elaborated as follows.

The abstraction of categories as kinds can be understood as the ancient Greek method of *diairesis*. Literally ‘division’, it is now commonly glossed over as the ‘Socratic method’. There is, however, a difference. The latter extends the former by insisting on the division of the genus being dichotomous so that tracing the steps back from the (found) species, should produce the terms that define that species. Unfortunately, this does not work, as Aristotle recognized. While it is a useful method of *investigation* (*APo* II.5) it is insufficient as a method of *definition* (*APr* I.31). The problem is that while the differentiae serve to subdivide a genus into its component subsets, they themselves are not peculiar to that genus. Plato describes

⁶ One of the ways in which Aristotle is thought to have arrived at the categories is by asking questions and analysing all possible answers, but the problem with this is that “Aristotle does not have a category corresponding to every one-word Greek interrogative, nor do all of his categories correspond to such interrogatives” (Ackrill 1963, p. 78–79). No, the real problem is that asking questions indiscriminately presupposes that the categories are an unordered set, which is not the case as we pointed out in the *Introduction*.

diairesis in the *Phaedrus* (and other treatises) as the “seeing together things that are scattered about everywhere and collecting them into one kind” (265D3-4) and then to “cut up each kind according to its species along its natural joints” (265E1-2). This presents diairesis as simply a method of investigation and, indeed, Plato says that Hippocrates already used this method (270C9) and that it is “the way to think systematically about the nature of anything” (270D1) and then continues to describe it (270D2-9). This view is corroborated by Proclus who describes diairesis as the method.

which divides into its natural parts the genus proposed for examination and which affords a starting-point for demonstration by eliminating the parts irrelevant for the establishment of what is proposed. This method also Plato praised as an aid in all the sciences.

(Proclus 1992, p. 166)

The difference, then, between diairesis as investigation and diairesis as Socratic method is one of *divisio utens* versus *divisio docens* (Mansfeld 1980), i.e. praxis versus theory. The second part of the method to be followed is the former in that it effectively proceeds by ‘collecting’ the members of a genus on the basis of being *similar* and ‘cutting off’ the various ‘other’ species on the basis of being *different* which is effectively the traditional, or Aristotelean, method of definition *per genus et differentiam* (van Polanen Petel 2007).

The third part of the method applies the part-whole relationship already discussed by Plato (e.g. Harte 2002), but extends it with the figure/ground ambiguity mentioned earlier. As applied here, it means that it is both possible to assume a *mental* perspective and imagine the *internal* relations and see something as a whole consisting of parts as well as to assume a *physical* perspective and observe the *external* relations and see something as a part of some larger whole. The two perspectives together thus form a Gestalt, a whole that is greater (or other) than its parts. Interestingly, while it seems reasonable to assume that ‘solving’ Rubin’s reversible pictures requires intelligence, the origin of the notion of a part-whole relation is likely to be a wondering how things fit together or how they might work, effectively a concern with the *insides* of things (cf. Murphy 2002 pp. 366–369 and Gelman 2003 pp. 79–82). This concern with ‘insides’ can safely be assumed to be innate, because creatures lower on the evolutionary ladder have it too as can be seen in a raven waiting until, for example, a cat is quite dead before trying to eat an eyeball. However, the foregoing example might perhaps be better explained by the raven wondering whether the object under consideration (the cat) still has agency (is alive and therefore potentially dangerous); a promising area for further research.

2.7 Conclusion

We can now finalize our working hypothesis to the effect that while Choice is the First Principle of the categories we analyze Choice into Separation, Aggregation and Ordering such that these three together will be the First Principles of the categories.

3 Deriving the Categories

The main thrust of this paper is the analysis of Aristotle's notion of 'substance' as originally prompted by his distinction between primary and secondary substance. Thus, it is *not* an analysis of 'substance' per se as might be suggested by Aristotle's comment in the *Metaphysics* "The question which, both now and in the past, is continually posed and continually puzzled over is this: what is being? That is to say, what is substance?" (1028b2-4).⁷ That would be the wrong question to ask with regard to the model, because the model does not provide answers to what something *is*, but only provides the categories to denote, define and describe instances of whatever 'something' is interpreted *as*. The solution to the problem could be to accept Aristotle's claim that matter is unknowable in itself (at 1036a8) and focus instead on what could constitute an 'individual', but a proper discussion of that is beyond the scope of this paper.

The distinction between primary and secondary substance suggests that the term 'substance' is to be understood as *proximate* substance. A proper definition of the notion then needs to account for what the substance is near to or, more precisely, for what its *context* is. Thus, the difference between 'Socrates is a man' and 'Socrates is an animal' must be understood in the category of Relative. Certainly, taken out of context both statements will be true, but only one can be felicitous at the moment of utterance, in other words, whether it makes sense to say that Socrates is a man or an animal depends on the context. If, for example, Socrates were standing next to a donkey then saying that he is an animal would be true, but not felicitous, though if he were standing next to a tree it would be both true and felicitous.

3.1 The Pre-Linguistic Concept of Something

The senses present phenomena to the mind as *impressions* which are retained in ever growing numbers of representations that represent the "blooming, buzzing confusion". The term comes from the Stoics who thought of it as a phenomenon impressing itself on the mind.⁸ However, rather than 'impression' we use 'something', because the notion conveniently blurs the distinction between outside and inside, i.e. between percept and concept, allowing expressions such as 'I thought of something'. The result is the level-0 concept that enables us to know something *qua* something. The concept is a *logical form* as in '___?' and '___!' (fill in the blanks). By itself it provides no information, but maps onto the awareness space which links the impression with the phenomenon and thereby affords the grounding of any representational

⁷ Preferring here the translation by Jonathan Barnes (1995a) over the standard one by David Ross. (It would be nice if the community could agree to make Aristotle's works an open source project so that we can develop a *real* standard.)

⁸ In the classical distinction, what is 'out there' is a phenomenon and what is 'in here' is a noumenon where the latter constitutes our knowing the former (Sextus Empiricus 1933, I.xiii.33). The problem here is that the current understanding of 'noumenon' derives from Kant (1781) notwithstanding Schopenhauer's (1819) criticism that Kant had hijacked the term to suit his own purposes. Using 'noumenon' here might confusingly evoke Kant's usage.

Table 1 Simple concepts: The categories of denotation

		<i>Intrinsic</i>	<i>Extrinsic</i>
SOMETHING	⇒	OBJECT	REFERENCE

content. As the root, or *summum genus*, of the conceptual structure it doubles as the category SOMETHING.⁹ It is by giving an *interpretation* to this ‘something’ that the categories have application. For example, both a shake of the head (in most cultures) and the word ‘no’ (in English) indicate a denial. The immediate conclusion is that Aristotle’s “things that are said” (*Cat* 1a16) can be regarded as ‘somethings’ and, while he appears not to have thought of that phrase as constituting a category, it stands to reason that it should be so considered. It is fitting that he mentions it at the beginning of the *Categories*.

3.2 The Simple Concept of an Individual

Applying the Principle of Separation is the first cut. It goes along the natural joint of what does and does not belong to the ‘something’ in the awareness space. What *does* belong to a ‘something’ is its substance and what does *not* belong is our way of referring to that ‘something’, essentially distinguishing between Aristotle’s ‘primary substance’ and its *name*. What this means is that applying the Principle of Separation constitutes a reanalysis of ‘somethings’ into *individuals* in the sense of “the individual man or the individual horse” (*Cat* 2a15) or “the individual tree” (*Cat* 2b15), effectively analyzing the “blooming, buzzing confusion” into a tapestry of individuals which affords choosing one individual to the exclusion of all others. The result is the level-1 concept that sets out the categories of denotation which enable us to both know something *qua* individual as well as to denote that individual. The Principle of Separation asserts the distinction between what does and does not belong, i.e. between *intrinsic* and *extrinsic* values, giving the categories of OBJECT and REFERENCE. The result is the grid of Table 1 below.

In his list of categories at *Cat* 4 Aristotle conflates primary and secondary substance, but adds at the start of *Cat* 5 that the former refers to individuals and the latter to their species. (Why he did not list both as separate categories is not known, but will be commented on later.) Hence we interpret his ‘primary substance’ as ‘philosophical object’, i.e. something that we can say something of, abstracted here to the category OBJECT (and note that a ‘subject’ is merely such an object that occupies the subject position in a sentence). References are not intrinsic, so the category REFERENCE will collect pronouns, names and proper names (which includes ‘that’). And note that Aristotle opens his corpus with a discussion of names (*Cat* 1). Again,

⁹ The Stoic ‘something’ as a ‘super category’ would seem comparable, but their notion appears to be conflicted (c.f. Long and Sedley 1987; Menn 1999; Brunschwig 2003).

Table 2 Basic concepts: The categories of definition

<i>Intrinsic</i>	<i>Extrinsic</i>		<i>Intrinsic</i>	<i>Extrinsic</i>	
OBJECT	REFERENCE	⇒	<i>Necessary</i>	SUBSTANCE	QUANTITY
			<i>Contingent</i>	QUALITY	RELATIVE

while he appears not to have thought of ‘primary substance’ and names as constituting separate categories, it stands to reason that they should be so considered.

3.3 The Basic Concept of a Particular

Applying the Principle of Aggregation is the second cut. It goes along the natural joint between what is necessary and what is contingent, providing the means of “seeing together things that are scattered about everywhere and collecting them into one kind” (Plato, *Soph* 265D3-4). Applying the Principle of Separation gives rise to the level-1 concept of an individual. Applying the Principle of Aggregation to the tapestry of individuals constitutes a reanalysis of individuals into *particulars*, in the sense of ‘instance of a universal’, effectively analyzing the “blooming, buzzing confusion” into a tapestry of individuals of a particular *kind* which affords choosing one particular individual rather than another. The result is the level-2 concept that sets out the categories of definition which enable us to both know something *qua* particular and to define that particular as an instance of that universal. The Principle of Aggregation asserts the distinction between what is *necessary* and what is only *contingent*. Thus, it is necessary for something to have some *substance*, but it will only contingently have some *quality* and it is necessary that there be some *quantity* of it, but it is only contingently *relative* to something else. The process splits the categories of the simple concept along the necessary-contingent axis, resulting in the 2×2 grid of Table 2 below (retaining substance here for clarity).

Note that the categories of definition are “the four familiar divisions” of *Physics* 195a15. Also note that the categories QUANTITY, QUALITY and RELATIVE fulfill a like function as in the Predicate Calculus where they correspond with quantifiers, qualifiers and connectives.

3.3.1 Constructing the Basic Concept

The basic concept is constructed through the process of diairesis, or division. Plato describes it in the *Phaedrus* as the “seeing together things that are scattered about everywhere and collecting them into one kind” (265D3-4) and then to “cut up each kind according to its species along its natural joints” (265E1-2). In effect, the process collects the members of a genus on the basis of being *similar* and cuts off the

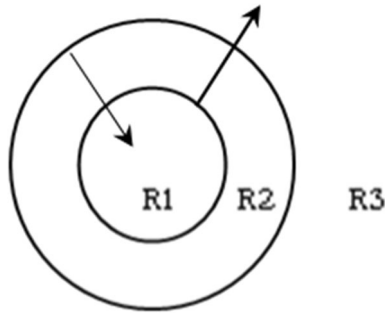


Fig. 1 Field of vision

various other species on the basis of being *different*, i.e. the traditional method of definition *per genus et differentiam*. The process can be visualized as follows.

Imagine a cake topped with a tapestry of variously colored tiny tubes of sweetened starch, popularly called ‘sprinkles’ and let this be our field of vision. We pick a single sprinkle for exemplar, place it in the middle, call it p and draw a circle around it. This gives us two regions, the domain $\{D: p\}$ and the counter domain $\{CD: \neg p\}$, which is not very useful so we examine our sprinkle and note its shape S and color C . Now taking the first step of diairesis, we collect all sprinkles that are similar in *either* respect and place them inside the circle, expanding it as we go. This gives us domain $\{D: (Sx \wedge Cx) \vee (Sx \wedge \neg Cx) \vee (\neg Sx \wedge Cx)\}$ and counter domain $\{CD: (\neg Sx \wedge \neg Cx)\}$. And this makes domain $\{D\}$ into the genus. Taking the second step of diairesis, we cut off from the genus $\{D\}$ those sprinkles that are similar in *both* respects, place them in the middle of $\{D\}$ and draw a circle around them giving us Fig. 1 (*without* the arrows). This means we now have the species as represented by region $\{R1\}$ as well as the genus, because the area $\{R1 \cup R2\}$ is still domain $\{D\}$. But the method of diairesis allows more to be concluded as can be seen from Fig. 1 *with* the arrows.

The inward pointing arrow indicates that the outer circle *includes* all sprinkles that are *similar* to our sprinkle, $\{R1 \cup R2: Sx \vee Cx\}$ and the outward pointing arrow indicates that the inner circle $\{R1\}$ *excludes* all sprinkles that are *different* from our sprinkle, $\{R2 \cup R3: \neg Sx \vee \neg Cx\}$. What this means is that while $\{R1 \cup R2\}$ is the domain, the counter domain is not $\{R3\}$, but $\{R2 \cup R3\}$. Area $\{R2\}$ contains all sprinkles that are similar to or different from the species and $\{R3\}$ contains those other than the genus, those *relative* to which the species is defined, in other words, the context of the definition.

Figure 1 shows that definitions effectively assert *boundaries*. A boundary determines what is and what is not, part of something. Region $\{R2\}$ constitutes the *overlap* of domain and counter domain. This overlap can be thought of as representing the slack of the definition and the amount of slack can be understood as the inverse of the degree of precision of the definition in the sense of the degree of *otherness* that is tolerated within the category, such that the larger the genus is the more ‘other’ it includes (see van Polanen Petel 2007).

Table 3 Basic concepts: The categories of definition (repeated from Table 2)

	<i>Intrinsic</i>	<i>Extrinsic</i>
<i>Necessary</i>	SUBSTANCE	QUANTITY
<i>Contingent</i>	QUALITY	RELATIVE

3.3.2 Assigning the Categories

Definitions out of context are not informative, simply because without context there will be no referents for the various symbols used, specifically, there must be a world (real or imaginary) where those referents exist or, in a pragmatic sense, can be found otherwise there can be no grounding and consequently no meaning. With the simple concept the referent is obtained directly, with the basic concept it is obtained indirectly, that is, *relative* to something else. The regions of Fig. 1 map onto Table 3 below as follows.

- The species $\{R1: Sx \wedge Cx\} \rightarrow$ SUBSTANCE,
- The context $\{R3: \neg Sx \wedge \neg Cx\} \rightarrow$ RELATIVE,
- The difference $\{R1 \cup R2: \neg Sx \vee \neg Cx\} \rightarrow$ QUANTITY and
- The similarity $\{R1 \cup R2: Sx \vee Cx\} \rightarrow$ QUALITY.

Table 3 represents the result of applying the two Principles of Separation and Aggregation. It is the basic concept that enables us to know something *qua* particular. Aristotle’s text of the *Categories* will suffice for examples.

3.4 The Subtle Concept of a Relational or Gestalt

Applying the Principle of Ordering is the third cut. It goes along the natural joint between what can be observed and what needs to be imagined. Specifically, it goes between the *internal* and *external* relations of something, providing the dual perspective of seeing something both as a whole consisting of parts and as a part of some larger whole. The subtle concept is constructed by extending the part-whole relationship with the figure/ground ambiguity of Gestalts. Specifically, it demonstrates that it is always possible in principle to entertain two different perspectives. It is both possible to assume a *mental* perspective and imagine the *internal* relations and see something as a whole consisting of parts as well as to assume a *physical* perspective and observe the *external* relations and see something as a part of some larger whole. The two perspectives together form the Gestalt. Crucially, however, the part-whole and the whole-part perspectives allow us to distinguish between *things* and *events*. Intuitive as this might seem, there is considerable controversy about how to define events (e.g. see Bennett 1988) so it will be convenient to stipulate that an

Table 4 Subtle concepts: The categories of description

		thing perspective	
		<i>Intrinsic</i>	<i>Extrinsic</i>
<i>Necessary</i>		MATTER	WHERE
<i>Contingent</i>		BEING-AFFECTED	HAVING

<i>Intrinsic</i>	<i>Extrinsic</i>	
<i>Necessary</i>	SUBSTANCE	QUANTITY
<i>Contingent</i>	QUALITY	RELATIVE

⇒

		event perspective	
		<i>Intrinsic</i>	<i>Extrinsic</i>
<i>Necessary</i>		PROCESS	WHEN
<i>Contingent</i>		DOING	BEING

‘event’ is an ‘identifiable part of a process’, something that happens, has some duration and is characterized by *change* (though without any attributions such as ‘causation’ or ‘reason why’). Importantly, it is in all cases the decision to allow for the presence of a (philosophical) subject (anthropomorphically if needs be) that determines whether to view a phenomenon as an event or a thing. The defining criterion for being a subject is assumed to be the ability to initiate or end motion, to do or to cease doing something, but more specifically, the ability to affect *change*, because that is what characterizes the transition from one step in a process to the next, i.e. from one event to the next.

Applying the Principle of Separation gives rise to the level-1 concept of an individual. Applying the Principle of Aggregation and the Principle of Separation together gives rise to the level-2 concept of a particular. Applying the Principle of Ordering to a particular constitutes a reanalysis of that particular into a *relational* both in the sense of how its component parts are related to the whole they are part of as well as in the sense of how it, as a component part of some larger whole, is related to the other component parts of that whole; more concisely, how that particular is *ordered*, both internally and externally. The result is the level-3 concept that sets out the categories of description which enable us to know something *qua* Gestalt and to describe something both as a thing and as an event. The Principle of Ordering asserts the distinction between what can be *observed* and what needs to be *imagined*. Thus, viewing something as a thing requires observation, but viewing it as an event requires imagination. The process splits the categories of the basic concept along the mental-physical, or internal–external axis, resulting in a triple dichotomy of eight categories. However, since a 3-dimensional grid tends to obscure bits, Table 4 below displays two 2 x 2 grids which has the added advantage of clearly showing the two perspectives. The four categories of the basic concept are SUBSTANCE, QUALITY,

QUANTITY and RELATIVE. These are analyzed as aspects of the thing/event pair as follows. SUBSTANCE is here analyzed into MATTER and PROCESS, QUANTITY is analyzed into WHERE and WHEN, QUALITY is analyzed into BEING-AFFECTED and DOING and RELATIVE is analyzed into HAVING and BEING.

3.4.1 Constructing the Subtle Concept

The construction of the subtle concept can be visualized as follows. Consider the tapestry of individuals. Any individual is a part of the whole of the tapestry, but is by itself also a whole with parts. If we represent an individual as a cube then we get a relational by cutting through its faces giving eight little cubes arranged together as a cube. The two sets of four cubes resulting from the third cut represent the two complementary sets of the categories of description, specifically, the two perspectives, which together constitute the Gestalt, that is, the thing perspective and the event perspective. The move from part-whole perspective to thing perspective should be obvious; the move from the whole-part perspective to the event perspective is elaborated as follows.

Concerning any object, taking a part-whole perspective, means analyzing the relations that obtain as *external* to the object, taking a whole-part perspective, means analyzing them as *internal* to the object. Illustrative is Hans Reichenbach's (1956, p 225) example of a house (perhaps after Aristotle's *Physics* 194a25-26). The heap of bricks and beams that results upon tearing it down is materially identical to that house, but is clearly not the same as that house. The relations between the bricks and beams are external to those bricks and beams, but internal to both heap and house. What distinguishes a heap from a house is the same as what distinguishes a stack of bricks from a wall and are what he called the "constitutive relations between the elements" (Reichenbach 1938, p 105–107). (Aristotle would call the absence of these constitutive relations a "privation of arrangement" *Met* 1033a16.) However, the distinction is between a unity and an aggregate, between necessary and contingent relations and this applies even to a heap of sand. Because for any individual grain of sand, the various relations it has with other grains are entirely contingent upon the structure of the heap, yet in any case it will remain that same grain of sand. But the situation is different for the heap, because while for each change in the relations between its constituent grains it will be qualitatively different, it will yet remain quantitatively the same and this effectively says that the internal relations of the heap are necessary for being that particular heap. However, the set of all external relations of all grains is identical to the set of all internal relations of the heap so that the distinction between the two is just a difference of perspective.

The part-whole perspective versus the whole-part perspective is also the distinction between chaotic and structured. Ostensibly, the organization of the heap of bricks and beams is chaotic, save for the question of how to represent a house. Taking a part-whole perspective means attending to the *order* within which something is embedded, but prior to that it would have meant attending to the *similarities* that obtain and prior to that attending to the *differences*. For the house, seeing the differences means taking a *simple* view, noticing its appearance and giving it a name, seeing the similarities means taking a *basic* view and defining it as the Edwardian

one, seeing the order means taking a *subtle* view and describing it as the n^{th} number on the street or as the building that houses some particular family. Thus, while the whole-part perspective is all-encompassing, the part-whole perspective is subject to the scope of attention or, rather, to the depth of analysis. From a part-whole perspective there is no presumption of understanding why the whole is the way it is, from a whole-part perspective there is. Indeed, it is the seeing of the relations between those parts, that shows the whole. While initially the world might appear to the infant as a “blooming, buzzing confusion”, the world as *sensed* is only chaotic until it is interpreted as having some structure or, rather, it is the *imposition* of order on the chaos that shows the structure and effectively results in seeing the world as *acted upon*. (The latter in the sense of Robinson’s 1954, p. 139 distinction between words that describe the world and words that are judgments that intervene in the world.) In the house example, the heap of bricks and beams would be chaos to the lay person, but to an experienced builder with a blueprint in hand the heap would be the jumbled parts of the house as a whole.

The part-whole opposition is the same as the simple-complex one. Seeing something as a part of some larger whole means treating it as *simple*, seeing something as a whole consisting of parts means treating it as *complex*. Here ‘simple’ means ‘opaque’ and ‘complex’ means ‘transparent’ and Herbert Simon (1962) argues that there are two different ways to describe a complex something, namely state descriptions and process descriptions. The former describe the world as sensed, the latter as acted upon. State descriptions describe some desired state of affairs and process descriptions describe how to achieve that state of affairs. Simon’s examples of the former were “pictures, blueprints, most diagrams, chemical structural formulae”, of the latter “recipes, differential equations, equations for chemical reactions” (1962, p. 479). Alternatively, state descriptions describe some (abstract) object and process descriptions describe how to construct such an object. For example, a recipe is only a true representation of the cake for those who can act on it, i.e. bake the cake. But here there is a distinction between the beginner and the expert. The former needs detailed and step-by-step instructions, the latter can do with just a list of ingredients and, of course, something like a sauce blanche could be an outcome for the former, but an ingredient for the latter. Taking again the house example, a proper state description would give the relevant facts, being a list of materials to describe the heap of bricks and beams, and a blueprint to describe the house. What the experienced builder then does is reanalyze the state description into a process description, effectively performing a means-end analysis (e.g. Newell and Simon 1972), such that the heap of bricks and beams is virtually a house but for putting everything back in order again (assuming nothing was damaged when the house was torn down).

The difficulty with the house example is that the state description represents it as a single thing while the process description reconstituting it represents it as a multitude of steps. But as the cake baking example shows, a process can be contracted into a single step just as a single step can be expanded to a sequence of steps. In other words, a process as a single step is opaque, a process as a sequence of steps is transparent. The parallel with things and events should now be obvious. State descriptions describe things and process descriptions describe events. Accordingly, the constituents of things are things and the constituents of events are events, but

everything can yet be viewed from either a thing-perspective or an event-perspective. In addition, things are synchronic while events are diachronic so that it can also be said that a piece of matter is just a class of events (Reichenbach 1947, p. 267) or a string of events (Russell 1927, p. 246), but ultimately that “a thing is a monotonous event; an event is an unstable thing” (Goodman 1977, p. 259). (A living body is an event and only a thing after all physiological activity has ceased.) Things endure, events have duration; things are located in space, events are located in time.

3.4.2 Assigning the Categories

The *Categories* contains but little detail about the minor categories. There are the five lines of the first paragraph of *Cat* 9 on Doing and Being-affected and there is *Cat* 15 on Having, but neither suggests anything of the thing-event distinction. Fortunately, here the commentators are of help. Firstly and as already mentioned, Simplicius (2000) reports Porphyry and Iamblichus as saying that the minor categories supervene on the major categories (297, 24–27) which indicates an essential distinction between the two sets. Secondly, Ammonius claims that.

The other six arise from the combination of substance with the remaining three. For from the combination of substance and quantity arise the two categories of *where* and *when*. Again, from the mingling of substance and quality arise two others: *doing* and *being affected*. From the combination of substance and relatives arise the two remaining categories: *being arranged* and *having on*.

(Ammonius 1991, 92, 9-13, italics in translation).

Clearly, this shows that the minor categories can be sorted into two groups as well, but Ammonius does not say which categories go together. However, recall here our argument in *The model of cognition* that the minor categories can be grouped as follows. The one group is {Doing, When, Being-in-a-position} the other is {Being-affected, Where, Having}. Assigning the minor categories to Table 5 below should be self-evident then.

Subtle concepts allow us to know something *qua* Gestalt. Observing the external aspects of a Gestalt effectively means interpreting the Gestalt as a *thing*, being a part of some whole and existing in the physical world outside, imagining the internal aspects means interpreting it as an *event*, being a whole with parts and existing in the mental world inside. Accordingly, Table 5 represents the *external* and *internal* aspects of Gestalts, respectively. Aristotle’s Substance has been analyzed into MATTER and PROCESS to reflect the thing-event distinction. The other labels are taken from Ackrill’s translation. Aristotle’s Being-in-a-position has been reframed to Being-disposed in view of the close correspondence with the Final Cause of the Four Causes (which we will discuss later) and then further generalized to BEING (note, *not* ‘being’ as discussed in the *Metaphysics*) in order to reflect the linguistic distinction between habere and non-habere languages, for example, French ‘J’ai faim’ (= ‘I have hunger’) versus English ‘I am hungry’. His examples for WHERE, WHEN, BEING-AFFECTED and DOING from *Cat* 4 should suffice, HAVING and BEING need some elaboration.

Table 5 Subtle concepts: The categories of description (repeated from Table 4)

		thing perspective	
		<i>Intrinsic</i>	<i>Extrinsic</i>
<i>Necessary</i>		MATTER	WHERE
<i>Contingent</i>		BEING-AFFECTED	HAVING

		<i>Intrinsic</i>	<i>Extrinsic</i>	
<i>Necessary</i>	SUBSTANCE	QUANTITY		⇒
<i>Contingent</i>	QUALITY	RELATIVE		

		<i>Intrinsic</i>	<i>Extrinsic</i>
<i>Necessary</i>		PROCESS	WHEN
<i>Contingent</i>		DOING	BEING

HAVING and BEING concern the ordering of the *external* and *internal* relations of a Gestalt, respectively. The part-whole perspective attends to the whole of the picture which effectively foregrounds the *ground* such that the figure becomes *part of the ground*. As a consequence, the various relations are seen as *external* to the figure and in the category of HAVING. The whole-part perspective attends to some part of the picture which effectively foregrounds the *figure* such that it becomes the whole and its various constituents are then the *parts*. As a consequence, the various relations are seen as *internal* to the figure and in the category of BEING. Aristotle’s *Cat* 4 examples of Having are “has shoes on” and “has armour on” and represent the external relations between a body and a pair of shoes or between a body and a suit of armour. Reframed as BEING, they would be “is wearing shoes” and “is wearing armour”. His examples of Being-in-a-position are “is lying” and “is sitting” and represent the internal relations of who or what is doing the lying or the sitting. Reframed as HAVING, they would be “has a lie-down” and “has a seat” (as in the invitation “Have a seat”). (Note that problems of interpretation of the use of these verbs might arise such that some uses would more properly fall under some other category; Aristotle discusses some in *Cat* 15 and *Met* V.23.)

For an example, consider the state of affairs on some mountain slope with a boulder in some scree and a mass of smaller stones piled up against its upward side. Viewed on a *thing* perspective, the *state* description just given will suffice, but viewed on an *event* perspective we need to give a *process* description. Accordingly, we *personify* the boulder, the scree and the mass of smaller stones as agents *doing* something, viz. we describe the boulder as *maintaining* its balance and *preventing* the smaller stones from *rolling* down or, alternatively, describe the boulder as having come to *rest* after, presumably, having *rolled* down from higher up. If the boulder would *lose* its balance it might *cause* the scree to *flow* down the slope and come

to *rest* at the bottom, but until then the scree would simply be a mass of stones *lying* on the slope. Thing-wise, the boulder is within some context that can be described in greater or lesser detail, event-wise, the boulder itself is the context and an agent whose doings can be described variously.

For a more precise example, a fired brick in Reichenbach's wall will suffice. Taking the thing perspective, we give a state description and say that it consists of baked clay (MATTER), is in the wall (WHERE), is prevented from slipping out of its place (BEING-AFFECTED) and has other bricks around it (HAVING). Taking the event perspective, we give a process description and say that the clay has become a brick (PROCESS), exists now (WHEN), is strengthening a partition (DOING), and is homogenous (BEING).

4 Some Consequences

4.1 The Number of Aristotle's Categories

The question of whether the list of categories at *Cat* 4 is supposed to be complete has through the ages had varied responses which this paper hopes to have put to rest. Indeed, we suggest that it is as complete as Aristotle could make it, given that the concept of a Gestalt was not known at the time. But there is another way of looking at the question.

While Aristotle lists ten categories he describes *eleven*. Substance is divided into two: primary substance and secondary substance. And in *On the soul*, he actually lists this primary substance separately when he asks "is [the soul] 'a this-somewhat', a substance, or is it a quale or a quantum, or some other of the remaining kinds of predicates which we have distinguished?" (402a24-25). And again when he says that "things are said to be in many ways: 'be' signifies of a 'this' or substance, or a quantum, or a quale, or any other of the kinds of predicates we have distinguished" (410a13-14). Clearly, this raises the possibility that eleven categories were shoe-horned into ten, but to substantiate that possibility, consider Sorabji's comment that "Plato's pupils Speusippus and Xenocrates saw Plato as being in the Pythagorean tradition" (1987, p 9). What this can be taken to mean is that the Pythagorean tradition was alive and well at the time and, with ten being a special number there, Aristotle might just have been careful not to offend his teacher. (Ascribing Pythagorean beliefs to Aristotle would surely be incongruous.) However, given the considerable debate amongst scholars regarding the exact nature of the relationship between Plato and Pythagorean thought (e.g. Huffman 2019, § 3.7) we will not pursue this further, though it is obviously a topic worth investigating further.

4.2 The Sequence of Aristotle's Major Categories

The main problem of the sequence is that Aristotle did not provide any principle(s) from which to derive his categories, although he did say in the *Metaphysics* that "if [the universe] coheres by virtue of succession [...] substance is

first and is succeeded by quality and then by quantity” (1069a20-21). This statement has prompted commentators to offer a variety of solutions. Two noteworthy examples are as follows. Thomas Aquinas introduced the notion of something flowing from one category to the next by saying “being must then be narrowed down [...] on the basis of a different mode of predication, which flows from a different mode of being” (1995, §§ 890, 892), though he gave no definition of this flow. Franz Brentano (1862) justified the order by postulating a scale of degree of being with substance “of which all else is predicated” at the one end and relation “which is virtually without being” at the other (pp 100–101). His construction of this scale was by a principled method of division on the basis of “the fourfold distinctions of accidental being, being in the sense of being true, being of the categories and potential and actual being” (p 3) which forms the starting point of his thesis and which he supports with passages found in Aristotle’s writings. The result is a tree, annotated with references, with the categories as leaves (p 117). Apart from placing relation last, the list maps onto Aristotle’s list at *Met* 1017a25-26.

A further problem is that the sequence in the *Metaphysics* is different from the ones in the *Categories* at 1b25-27 and in the *Topics* at 103b21-22 and that both Brentano and the *Metaphysics* list <quality, quantity> whereas the *Categories* and the *Topics* list <quantity, quality>. Perhaps, the difference reflects Aristotle’s maturing between the *Categories* and the *Metaphysics* (e.g. Irwin 1988, p. 11, referring to Owen 1986a, b), but it could also be that Aristotle had a different purpose in mind for the earlier versus the later treatise. If so then, possibly, the list in the *Categories* could be interpreted as intended to describe *secondary* substances, or instances of some kind, typically things, and the list in the *Metaphysics* as intended to describe *primary* substances, or beings. Accordingly, things are typically material whereas beings are essentially immaterial, as in the distinction between Socrates as body and Socrates as being, so that Brentano can say “On the other side stand the qualities, which are related to form as quantity is related to matter” (p 102).

The position this paper takes is that there is no order intrinsic to the categories, only such as is imposed for purposes of explication. Thus, there is an order in the progression from the simple to the basic to the subtle concept. However, mapping the 2-dimensional system of categories of the basic concept onto the 1-dimensional medium of a written sentence allows for only two orders. First applying Separation and then Aggregation means prioritizing *intrinsicness* while the other way around means prioritizing *necessity*. Thus, from a linguistic point of view the natural order is (using *I* for intrinsic and *N* for necessary) either.

<Substance_(+I, +N), Quality_(+I, -N), Quantity_(-I, +N), Relative_(-I, -N)>

or.

<Substance_(+N, +I), Quantity_(+N, -I), Quality_(-N, +I), Relative_(-N, -I)>

The list at *Met* 1017a25-26 exhibits the former order, the lists at *Cat* 1b25-27 and at *Top* 103b21-22 exhibit the latter order. Applying Ockham’s razor suggests that these orders are more likely to be a consequence of using the 1-dimensional medium of notation than to be caused by Aquinas’s flow or Brentano’s degree of being.

Table 6 The Four Causes as a basic concept

	<i>Intrinsic</i>	<i>Extrinsic</i>		<i>Intrinsic</i>	<i>Extrinsic</i>
<i>Necessary</i>	SUBSTANCE	QUANTITY	⇒	Material	Formal
<i>Contingent</i>	QUALITY	RELATIVE		Efficient	Final

4.3 Concerning Change

Aristotle says in the *Physics* that “men do not think they know a thing till they have grasped the ‘why’ of it” (194b19-20) to which he adds the parenthetic remark “(which is to grasp its primary cause)”. He then follows this with a discussion of the Four Causes, but not of the primary cause. This is appropriate, though, because toward the end of Book 1 he says “[the primary cause] is the province of first philosophy [...] but of the natural, i.e. perishable, forms we shall speak [next]” (192a35-192b1). The primary cause is usually sought in the *Metaphysics*, but here the *Nicomachean ethics* is more relevant in its discussion of the intentionality of change in the Seven Circumstances. We have earlier hinted at both the Four Causes and the Seven Circumstances. Here the two sections below elaborate and show how they fit in the categories, the former as definition and the latter as description.

4.3.1 The Four Causes

Interpreting ‘something’ as ‘change’ is too broad to say something meaningful about causation and, indeed, Aristotle used *aitia*, which meaning is perhaps closer to ‘explanation’, of which he lists four, hence the Four Causes. The traditional terms are Efficient, Material, Formal and Final. The standard references to the Four Causes are *Physics* II.3 and *Metaphysics* V.2. Aristotle explains them as follows (using the text of the *Metaphysics* at 1013a24-34).

- Efficient: “that from which the change [...] begins, e.g. [...] in general the maker a cause of the thing made”,
- Material: “that from which (as immanent material) a thing comes into being, e.g. the bronze of the statue”,
- Formal: “the form or pattern, i.e. the formula of the essence” and
- Final: “the end, i.e. that for the sake of which a thing is, e.g. health is the cause of walking”.

Here the same question of completeness can be asked as of the categories themselves, but in the *Physics* Aristotle then comments “All the causes now mentioned fall into the four familiar divisions” (195a15) and in the *Metaphysics* “under four senses which are the most obvious” (1013b17-18). And it does seem obvious that these four are indeed the major categories SUBSTANCE, QUALITY, QUANTITY and

RELATIVE. Accordingly, it is proposed that the Four Causes are *subsidiary* categories giving a definition of ‘causation’ as in Table 6 below.

Accordingly, Material is reasonably understood as an interpretation of SUBSTANCE (referring to proximate substance, not prime matter), while Formal can be an interpretation of QUANTITY in the sense of ‘definition’ (*Phys* 194b27), because “definition is a sort of number” (*Met* 1043b34-35). The Efficient can be an interpretation of QUALITY as in ‘affecting the *shape* of the material’ and Final an interpretation of RELATIVE as in ‘the plan *of* or *for* that house’.

As a point of interest, recall our quote from the *Introduction* “Therefore the nature of a thing is an origin, and so are the elements of a thing, and thought and choice, and substance, and that for the sake of which” (*Met* 1013a19-21) and note that Aristotle here lists *five* units (the placing of the commas indicates that “thought and choice” are ‘one of a kind’). We suggest that the difference with the Four Causes is that Aristotle here lists both primary and secondary substance, with “the nature of a thing” and “substance”, respectively. What the implications hereof are we leave to others to determine.

4.3.2 The Seven Circumstances

The Seven Circumstances are a list of questions probing the circumstances of some act. Six of these survive to this day as the ‘five Ws and a H’, i.e. *who*, *what*, *where*, *when*, *why* and *how*, and are used not just in journalism (as popularized by Kipling 1902), but even in police investigations (e.g. Clarke and Eck 2005, p. 36). Earlier, Durant Robertson (1946) reports that in medieval times priests of the catholic church used a set list of questions “to guide confessors in their consideration of circumstances” (p. 6–7). The need to take circumstances into consideration is shown by, for example, the consideration that where stealing is a sin, stealing from the Church is sacrilege (e.g. Austin 2009, pp 188–189). We now propose that the Seven Circumstances *complement* the Four Causes.

Robertson traces the Circumstances back to Hermagoras of Temnos, 1c BCE, but Michael Sloan (2010) shows that they originated with Aristotle’s *Nicomachean Ethics*, specifically to be found at 1110b31-1111a21. He notes that it is “an opaque passage [...], one that has continually been obscured in modern translations” (p. 236) and which “is riddled with vague constructions composed of prepositions combined with particles and relative, demonstrative and indefinite pronouns” (p. 237). In the current standard, the passage is translated by David Ross as follows.

Perhaps it is just as well, therefore, to determine their nature and number. A man may be ignorant, then, of who he is, what he is doing, what or whom he is acting on and sometimes also what (e.g. what instrument) he is doing it with and to what end (e.g. for safety) and how he is doing it (e.g. whether gently or violently).

(*NE* 1111a2–5)

However as Sloan complains, the passage begs a more precise and less opaque casting if the intent of the original is to be revealed and proposes the translation below.

Therefore it is not a pointless endeavor to divide these circumstances by kind and number: (1) the who, (2) the what, (3) around what place or (4) in which time something happens and sometimes (5) with what, such as an instrument, (6) for the sake of what, such as saving a life and (7) the how, such as gently or violently.

(Sloan 2010, p. 239, numbering in original)

Sloan's translation is arguably an improvement in that it adds When and Where.

Fitting the Seven Circumstances into Aristotle's 10 categories might seem to pose a problem, because forcing the Who into Substance would treat, for example, Socrates, as a *kind* which would make no sense. However, Aristotle makes Substance do double duty in representing both primary and secondary substance, which means that it is not really a problem. Robertson gives differing quotes of the Circumstances, but the one we will use here is the one he takes from Victorinus, "quis, quid, cur, ubi, quando, quem ad modum, quibus adminiculus" (= who, what, why, where, when, how, with what), because of the latter's assertion that "the first two are of primary importance, the last five being subsidiary to the second" (p 11). Now recall Simplicius's (2000) earlier mentioned report that the minor categories supervene on the major categories and note that these "last five" are clearly of the minor categories which means that the "second" (quid) must be the major category Substance in its sense of 'secondary substance' and that the "first" (quis) must be Substance in its sense of 'primary substance'. Note that this distinguishing between primary and secondary substance raises the tantalizing question of whether the churchmen were thinking of primary substance as an eleventh category, but pursuing that falls beyond the scope of this paper. Even so, to fit the Seven Circumstances in the categories we must do exactly that. The result is shown in Table 7 below and it is interesting to see that the 'Five Ws and a H' follow the same order as used by Victorinus.

The mapping of Table 7 below is tentative, but it would seem to confirm that as a description the Seven Circumstances do complement the Four Causes. However, with the benefit of hindsight, we can see that the Seven Circumstances as a complement to the Four Causes are not complete. We argue this as follows.

As mentioned earlier, the minor categories can be divided into two groups as follows.

The one group is {Being-affected, Where, Having} the other is {Doing, When, Being-in-a-position}. Clearly, these two reflect the thing-event distinction of the subtle concept. Now, the questions *ubi* (Where/around what place) and *quibus adminiculus* (Having/ with what) are from the thing-perspective which means that BEING-AFFECTED ought also to be part of the list, because it recognizes the possibility of *extenuating circumstances*. Also, because of this, we believe that Ross' part-translation "What or whom he is acting on" is inappropriate. Be that as it may, we have no doubt that Aristotle was aware of extenuating circumstances and that this can be found in the *Nicomachean Ethics*, but our knowledge of the corpus is far too little that we can sustain this so we must leave this to those who are better informed.

Table 7 Assigning the Seven Circumstances to the categories

Robertson	Ross	Sloan	Aristotle	The model	Five W's and a H	Clarke & Eck
Quis	Who	Who	Primary substance	REFERENCE	Who	Who was involved
Quid	What he is doing	What	Secondary substance	SUBSTANCE	What	What happened
Cur	To what end	For the sake of what	Being-in-a-position	BEING	Why	Why did they act as they did
Ubi		Around what place	Where	WHERE	Where	Where did it happen
Quando		In which time	When	WHEN	When	When did it happen
	What or whom he is acting on		Being-affected	BEING-AFFECTED		Who was involved
Quem ad modum	How he is doing it	How	Doing	DOING	How	How did the offender carry out the crime
Quibus adminiculus	What he is doing it with	With what	Having	HAVING		How did the offender carry out the crime

5 Summary and Conclusion

This paper has argued that the three Principles of Separation, Aggregation and Ordering suffice to derive a conceptual construct that accommodates Aristotle's categories at *Cat 4*.

The model of reality used is strictly from the perspective of and as experienced by the individual. It employs the tri-partition mental-formal-physical as recognized in various forms since at least the ancient Greeks. Outside is the physical world where we seek the ontics of some representation, inside is the mental world where we determine the meaning of that representation and at the interface between outside and inside is the formal world where we locate the representation itself, that is, the world *as-is*, the world *as-thought* and the world *as-represented*, respectively. The interface can be conceived of as an awareness space where we become aware of things and which is the link between inside and outside and thereby serves to ground representational content.

The proposed model of cognition maps onto the awareness space and serves as the *template* whereby we know things. It has the form of a four-level structure mapping onto the notion of 'something' with $1 + 2 + 2 \times 2 + 2 \times 2 \times 2 = 15$ *principal* categories. Because the concept of SOMETHING is a logical form that needs to be interpreted before it can have meaning, the number of *subsidiary* categories is only bound by the imagination, though still constrained by the principal categories. Any other system of categories that accepts 'something' as its *summum genus* will thereby be *equivalent* to the proposed model or if it does not it will need some First Principle and will thereby be *subordinate* and hence be subsumed.

The model is rooted on the *summum genus* of SOMETHING. Applying the three Principles of Separation, Aggregation and Ordering consecutively, results in three cuts across the summum genus. The first cut goes between what does and does not belong, the second cut goes between what is necessary and what is contingent and the third one goes between what can be observed and what needs to be imagined. The first cut gives a dichotomy of 2 categories, the second cut is across the first and gives a double dichotomy of 2×2 categories and the third cut is across both and gives a triple dichotomy of $2 \times 2 \times 2$ categories. This makes $1 + 2 + 2 \times 2 + 2 \times 2 \times 2 = 15$ categories. The three cuts result in the simple concept of *individual*, the basic concept of *particular* and the subtle concept of *relational* or *Gestalt*, respectively. The Gestalt is constituted out of the two perspectives of *thing* and *event*. Aristotle's categories, including those (bracketed) terms that he treated as categories, but did not recognize as such, are assigned to their corresponding places in the model as per Table 8 below.

As can be seen from Table 8, Aristotle's categories, including those he treated as such, have a near perfect correspondence with the conceptual structure as described in this paper. Only 'matter' and 'process' are missing from his corpus, but that should be no surprise as there is neither indication of his awareness of Gestalts nor any notion of 'event' to be found in his writings, which is not surprising since these are rather modern concepts. Mindful of Seneca's admonition

Table 8 Accommodating Aristotle's categories to the model

Aristotle's categories	categories of the model of cognition	concept	perspective
(Things that are said)	SOMETHING	Something	N/A
(Primary substance)	OBJECT	Individual	
(Name)	REFERENCE		
(Secondary) substance	SUBSTANCE	Particular	
Quantity	QUANTITY		
Quality	QUALITY		
Relative	RELATIVE		
	MATTER	Gestalt	Thing
Where	WHERE		
Being-affected	BEING-AFFECTED		
Having	HAVING		
	PROCESS		Event
When	WHEN		
Doing	DOING		
Being-in-a-position	BEING		

mentioned at the start that “the ancients must be listened to, indulgently. Nothing is completed while it is beginning”, this omission should be granted. Furthermore, the structure was shown to be capable of accommodating the subsidiary categories of the Four Causes as well as those of the Seven Circumstances, validating Aristotle's claim, implicit in *Cat 4*, that everything must fall within the categories.

The question we attempted to answer was how the categories can be constructed and we offered the model of cognition as an inference to the best explanation thereto. We assigned Aristotle's categories as seemed to fit best, but whether we have succeeded in this is left to more powerful thinkers. In addition, we noted the possibility of further avenues of research. Our aim in presenting this paper was to offset the skepticism mentioned by Amie Thomasson (2019) and cited in the *Introduction* so as to refocus the discussion on categories in general and to rekindle the interest in Aristotle's categories in particular. If we have succeeded in this all will be well.

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