

Chapter 2

The Conception of Abstraction

Philosophers have used ‘abstraction’ for a long time. As they offer theories and themselves critique the structure of their own theories, they have developed various conceptions of abstraction. Yet their critiques are not neutral. They come from their philosophical positions. In order to grasp Aristotle’s theory of abstraction, I thus find it useful to discuss his conception of ‘abstraction’ and where it fits into his philosophical landscape. With this preliminary sketch, we might endeavor to avoid anachronism.

As its Greek etymology suggests, abstracting (ἀφαιρέω) consists in taking away something from an object. The root verb, ‘αἶρέω’, suggests additionally a sense of grasping or of choosing, of taking for oneself something that lies ready to hand.¹

These lexical meanings leave open a wide range of conceptions of ‘abstraction’. Does the abstraction consist in taking out something and discarding the rest? Or does it consist in taking away something and keeping what is left? We can call the first one the selection view, and the latter the subtraction view. The Greek gives an ambiguity between the two because ‘ἀφαίρεσις’, being a verbal noun, could be derived from the active form ‘ἀφαιρῆν’, which generally does have the sense of ‘removal’, or from the middle form, ‘ἀφαιρέσθαι’ which generally has the sense of ‘take away for oneself’ or ‘steal’. On linguistic grounds of common usage, the selective reading of ‘ἀφαίρεσις’ has the advantage, as the middle voice forms are far more common than the active voice forms. Yet, as Aristotle is a philosopher, and philosophy stretches or distorts the ordinary usage of language, the philological evidence does not settle the issue. For that, we must turn to Aristotle’s texts.

¹LSJ s. v. ἀφαιρέω and αἶρέω.

2.1 Origins of Aristotle's Theory

Originally, so some have speculated, Aristotle may have developed his conception of abstraction (ἀφαίρεσις) in order to have an alternative to Platonism (Wieland 1962: 197 n. 12). Such an abstraction theory claims to provide a way to distinguish and recognize the different aspects of things, both universal and (perhaps) singular, but without granting any of these an independent, substantial existence *in re*, such as Plato claimed the Forms to have. On this account, we can consider an object with respect to some of its attributes, take them out, and thereby create a new abstract thing consisting in that object in only those respects. We can then use this new thing as a subject in its own right. Yet we have only one object, the original substance existing *in re*, although with many attributes. In contrast, for Plato, everything that is a subject in its own right is or refers to an object existing independently *in re*. In this way, the doctrine of abstraction lies at the heart of Aristotle's metaphysical enterprise, of constructing a theoretical alternative to Platonism.

For Aristotle, there is a natural basis for some such abstractions as opposed to others: some are scientific, like the genus dog and the *differentia* rational; others are sophistical, like “musical Coriscus” (Bäck 2000: 59–96). [*Metaph.* 1026b17–28] In making the scientific abstractions, we isolate the proper subjects for the statements being made about real attributes of individual substances. In this way, we can start from sense perceptions of individuals and arrive at sciences of universals like numbers, plane figures, and motion. Yet we are still talking about the real individual substances, not some fictitious, transcendent Forms, existing over and in addition to those individuals.

In accord with this approach, Aristotle explains how attributes are abstracted from individual substances in his account of perception, and how universals are abstracted from particulars in his account of thought. [*An.* III.4; *Metaph.* I.1; *Phys.* I.1] Likewise, he speaks of “cutting off a part of being” and making a science about it. [*Metaph.* 1003a24–5] Physics concerns substances *qua* movable; geometry considers substances *qua* figure. [*Metaph.* 1026a7–10; 1061a28–1062b11; 1077b22–1078a21] We start with the individual substances given in sense perception and then isolate aspects of them, *abstracta*, for study in particular sciences.

Aristotle seems to recognize several types of these scientific *abstracta*. First, he recognizes universals in all the categories. The sciences study universals: not only species and genera of substance like dog, rose, plant and animal, but also those from other categories, like square, figure, sight, perception, justice and virtue. As items in the categories exist and further as the sciences study only things that exist [*An. Po.* 89b31–5], clearly Aristotle holds these universal species and genera to exist in reality. Yet, if Aristotle is to avoid Platonism, it is thereby quite likely that he holds these universals, or our knowledge of them, to be abstracted somehow from singular things.

Second, Aristotle might recognize also singular *abstracta*, like mathematical objects (Mueller 1990: 463–4). For not only do scientists need to speak of number, triangle, bird, redness, and walking in general. They also need to speak of particular

instances of 'two' in ' $2+2=4$ ', of the particular triangles used in the diagram of a geometrical proof bisecting a square on the diagonal, and of more than one bird in the mating process. These particulars do not seem to be sense objects.² In modern terms, they seem to be tokens of a universal type. In support of this interpretation, Aristotle speaks of an intelligible matter and not of perceptible matter, providing a basis for having more than a single instance of a type of mathematical object. Thus he seems to be indicating that there can be several instances of the same species, differing in number, even when there is no corporeal matter to differentiate.³ [*Metaph.* 1036a2–12; 1059b14–6.] These instances are particulars of some type. For they are composed of matter and form, and, being singulars, are not definable. Aristotle seems to state clearly that some mathematical objects are individuals. [*Metaph.* 1036a2–3] But, if they are singular, they are individuals quite differently than the sensible individuals are.⁴

Whether these intelligible particulars be taken as universal or as particular, they are going to create complications for a theory of abstraction, especially if the mathematical objects cannot be physical, strictly speaking. For a diagram would then be a token of a type of sign signifying a mathematical object. These tokens too have a certain universality: it is not merely the ones here: ' $2+2=4$ ', on this particular page that are being discussed. Rather, when I write that equation, the marks on the page are signs not only of themselves but also of some other tokens or token types. In order to have that equation, we need two instances of the number two, each represented by an instance of the numeral '2'.

So we can see why Aristotle would think that mathematical objects need to have some sort of intelligible matter, in order to have many instances of the same species (or type) of number.⁵ Still, Aristotle thinks that they are "abstracted" somehow from our sense experience of the world.

Aristotle thinks also that the things thus abstracted are objects existing *in re* that are in some sense independent from their bases, the things from which they are

²Although some have argued that Aristotle or some Aristotelian commentators took geometry to be about the particular figures and diagrams perceived by the senses. See Mueller 1979 for a general discussion.

³Reeve (2000) also recognizes both universal and particular intelligible matter, as I shall discuss more below.

⁴Unless Aristotle holds that these individuals are abstracted directly from perceptions of individual substances. On this account, e.g., when I see a particular bronze sphere, upon abstraction I have also an individual sphere, the mathematical object. So too when I see the iron sphere I see another individual sphere. Also, looking at the spheres, I have upon abstraction an individual 2, an individual mathematical object. Cf. Simplicius, *in Cat.* 124, 28–125, 2. Yet, even so, if we are to have items in mathematics for which we have no exemplars *in re*, such as very large numbers or very complex geometrical figures, we still cannot reduce mathematical individuals directly to perceptible individuals.

⁵Moreover, as the equation itself can be stated or written in many particular speech acts or writing acts, the numeral itself will need to have some way to have many instances, just as we can have many repetitions of the same statement (λόγος), as when we all utter the same true sentence in a chorus. Yet Aristotle does not seem to pursue this issue much, although some medieval Aristotelians did, in subdivisions of material supposition.

abstracted. For the universal *abstracta* include the species and genera, the secondary substances that are the objects of science. To be sure, Aristotle does say that, if the individual, primary substances did not exist, neither would these secondary substances or accidents. [*Cat.* 2b5–6] Yet he does not deny that these species and genera really exist. So he seems to be saying that these abstract objects exist *in re*, but not independently and separately from their concrete individuals, the primary substances. Mind (*noûs*) makes these items separate in thought by separating them off from the whole sense perceptions of individuals.

One might then think that for Aristotle these *abstracta* are mere concepts, artifacts of the human mental process with no real correlates (Klein 1968: 100–13). That is, on human, pragmatic grounds, we might focus on certain features of individual things in a particular science. Still, such grounds do not give any assurance that this science does more than to provide a useful, heuristic model nor that its objects have more than a conventional unity.

Nevertheless, Aristotle has a different view. As he recognizes that universal substances and accidents exist *in re*, he is assuming that these *abstracta* have a real basis. In performing at least certain abstractions, the scientifically respectable ones, we are affirming or presupposing the real existence of common structures of individuals *in re*. In our sciences, we may then be said to be “recognizing” (ἀναγινώσκειν) a certain aspects of real things that apply in fact to more than a single individual in a basic sense of the word. That is, we are “re-cognizing”, or re-presenting again in thought, what already has *in re* a basis to be distinguished. A science then becomes more than a mere model but a “theory” (θεωρία) in an original, literal sense: of observing or looking at real structures existing in the world.⁶

So we have two basic phenomena or data about Aristotle’s conception of abstraction. First, a process of abstraction is not supposed to create or presuppose new objects existing *in re* over and about the individual substances given in sense perception. Aristotle does not take abstract objects to be real, self-subsistent objects. The species man does not exist *in re* over and above the individual human beings. Second, the abstract objects themselves do seem to include the universal substances and accidents, the universal species and genera asserted to exist and studied by scientists. So, on the one hand, abstract objects are not independent, and, on the other, they are objective: they are real although not independently real.

We see this tension exemplified in Aristotle’s account of substance in the *Metaphysics*. There again, he does not want the substantial forms to be separate, universal objects, existing independently from individual substances. At the same time, he wants them to be “objective”, to represent (“re-present”) structures present in these real individuals, not merely in our conventional thought. Aristotle wants objective universal structures but admits only individuals existing primarily *in re*. That is, Aristotle takes substantial forms to be abstract, merely abstract, objects. Aristotle uses abstraction to explain how we can come to know universals from having sense perceptions, to give an account of mathematical objects without

⁶“...objects in the world...present themselves as concrete individuals and simultaneously as exemplifications of universals” (Modrak 2001: 96).

positing universals *in re*, and to discuss the universal features of what it is to be an individual substance without relapsing, he thinks, into Platonism.

These explanations lie at the very core of Aristotle’s thought. Abstraction lies at the very core of these explanations. Accordingly, if we can but get clear on the structure of the sort of abstraction that he is using, we can gain insight into his theory as well as gaining increased ability to evaluate it.

2.2 The Meaning of ‘Abstraction’

The general discussion so far might suggest thinking of abstraction as extraction. Aristotle does speak of “cutting off a part of being” and making a science about it. Such talk suggests that we are cutting out, or extracting, certain aspects from the object and erecting them as separate objects. Yet this sort of extraction cannot be ‘extraction’ in the usual sense, though. E.g., when I “extract” a splinter from my foot, or gold from the ore, I end up with a pair of independent, individual substances: the splinter and my wounded foot, and the gold and the slag. If abstract objects were “abstracted” in this way, they would indeed have a separate existence over and above the individual substances from which they are abstracted. Thus Aristotle’s ‘abstraction’ would have to be thought of as a type of extraction where the items being extracted do not have a separate, independent existence. Consequently, it is not clear how helpful viewing abstraction as extraction is.

Accordingly, John Cleary has suggested that, rather, Aristotle conceives “abstraction” (ἀφαίρεσις) as a process of subtraction (Cleary 1985: 18–9, 1995: 304, 309–14). Here the individual substance remains, and we merely subtract everything that does not pertain to the respects stated. In support of his view, he notes that in the *Topics* Aristotle contrasts the method of “ἀφαίρεσις” with that of “πρόσθεσις”, which at the time had the common meaning of ‘addition’ in the arithmetical sense. [*Top.* 118b10–9; 140a33–b15; 152b10–6] Plato too, he says, seems to use ‘addition’ and ‘subtraction’ in this sense. [*Phaed.* 95c; *Euthyd.* 296b; *Cart.* 393d; *Prm.* 131d; 158c] Aristotle himself contrasts the natural scientist’s use of “addition” with the mathematician’s use of “subtraction”. [*Cael.* 299a14–8; *Phys.* 193b22–194a12; *An.* 403b9–19; *Metaph.* 1077b9–11]

Indeed, Cleary objects to calling ‘ἀφαίρεσις’ ‘abstraction’ altogether, partly because this translation suggests a conception of extraction, and partly because Aristotle does not view the process as psychological or epistemological, as in the later discussions of “abstraction” in Locke and Berkeley. For on their account of abstraction we make up general concepts or signs for our convenience after having experiences of individual existing *in re* (Locke, *An Essay Concerning Human Understanding*, II11.9; IV.7.9; Berkeley, *Principles of Human Knowledge*, “Introduction,” §§15–6). The things abstracted may have use for us but need not reflect real structures in reality: they may be far removed from the “secret springs” of physical objects (Hume, *An Enquiry Concerning Human Understanding*, V.1). In contrast, Aristotle holds the things abstracted to reflect reality.

Cleary insists that ‘ἀφαίρεσις’ does not signify the way by which we come to have a certain sort of knowledge. Rather, it is the way by which the primary subjects for each science are isolated: it is that by which we “chop off a piece of being” so as to make it the proper subject of a special science. We do this by subtracting or removing attributes from the totality of those constituting an experienced object until we get a primary subject. However, although we do the paring down, still the process is not so much a merely psychological process by which we come to have perception and science, as an objective process by which we come to be aware of the attributes and types of individual substances. That is, although abstraction is a mental process, it is grounded upon real distinctions between aspects of things in the world. Other, non-rational animals also make abstractions in their sense perceptions, memories, and imaginings, although they do not make the ultimate abstractions whereby rational beings can locate the proper subjects for science, the universals. Cleary then sees that for Aristotle abstraction proper is primarily an ontological process whereby we locate and isolate the primary subjects for each science from our perceptions of individual substances with their full array of attributes—not a way by which we come to know the objects that we are locating and isolating in a peculiarly human, conventional way of knowing.⁷

Cleary’s main evidence for Aristotle’s not viewing ‘ἀφαίρεσις’ as an epistemological process whereby we acquire knowledge of objects lies in this passage:

Now it is also evident that, if some [type of] perception is lacking, it is necessary also that some [type of] knowledge is lacking, if indeed we learn either by induction or by demonstration, where demonstration is from the universals and induction from the particulars, and it is impossible to contemplate the universal if not through induction (for since also those said from abstraction will be able to be made familiar through induction, because [or: that⁸] some things belong to each genus, even if not separate, *qua* each such thing [sc., the genus]), it is impossible for those who do not have the [type of] perception to make the induction [literally: be led to, sc., have the induction made for them]. For perception is of the singulars: for it is not possible to take knowledge of them: for neither from the universals without induction, nor through induction without perception. [*An. Po.* 81a38–b9]

The main points of the passage are clear: we have no acquaintance with singulars except through sense perception. We may then come to become acquainted with universals through induction on the singulars once acquired.⁹ Then we may come to have knowledge of universals through performing demonstrations on these universals. So all knowledge comes from, or depends upon, sense perceptions, directly or indirectly. [*Eth. Nic.* 1139b27–31] As Cleary stresses, Aristotle does not say here that we perceive or know anything through abstraction. Rather, we come to grasp “even the things said from abstraction” through induction. Consequently, abstraction appears to be a process different from induction or demonstration. Its products are “the things said from abstraction”. [*An. Po.* 81b3]

⁷The account of Cleary 1995: 308 agrees mostly with Lear 1982: 168.

⁸I agree with Cleary (1985: 15) that either translation is possible.

⁹Barnes (1975: 161) notes that Aristotle claims here only that induction can make abstractions familiar to us, not that it alone can do so. He claims that Aristotle argues for that stronger claim at *An.* 432a3–6 [discussed below].

This phrase (τὰ ἐξ ἀφαιρέσεως λεγόμενα ἔσται δι' ἐπαγωγῆς γνώρῃα ποιεῖν [81b3]) may appear ambiguous: it may signify those said from abstraction, sc., statements made as a result of abstraction, or the objects that we are now able to talk about as a result of the abstraction. Yet the dilemma of: words or objects? is misleading. For, as I have argued elsewhere, as Aristotle wants in his scientific language an isomorphism between the words and the objects, what is said will match the actual properties of those objects (Bäck 2000: 91). So we may as well take the phrase realistically, to mean the objects signified by such subject terms as 'triangle' and 'sphere'. Indeed, as Aristotle takes "the things said from abstraction" to be the objects for the mathematical sciences, and science concerns only what exists *in re*, he is committed to a realistic views of these things. Accordingly, I call the "things said by abstraction" 'abstract objects'.

Also, we might see two possible ways of understanding 'from' (ἐξ) in "the things said from abstraction". On one reading, we would be inventing abstract objects, by treating aspects of real objects as if they were real, independent objects, without their really existing as such. On another reading, we would be discovering real abstract objects. The former gives a nominalist reading; the latter a Platonist. As Aristotle insists that he rejects Platonist accounts of abstract objects, like the objects of mathematics, we should take the first reading. Yet, given that Aristotle speaks of cutting off parts of being and of secondary substances existing in their own right, he does seem to want these *abstracta* to be extracted so as to constitute independent objects, albeit derivative, dependent ones. So the nominalism will be a "realistic" nominalism, one making us wonder if Aristotle avoids Platonism. Hence Aristotle's theory of abstraction becomes crucial—for seeing if he does.

Aristotle has a *transcendent* sort of abstraction. For the abstraction goes beyond the original objects perceived so as to generate, or at any rate to recognize, new objects. We perceive individual things and then via abstraction are able to know the universal objects of mathematics. These new objects have quasi-independence if not a real independence. For, as they serve as the objects of the sciences, they are the most intelligible objects of the things that are. Abstract terms are more than mere *façons de parler*.

Aristotle says that these abstract objects become familiar to us through induction. Induction is a process whereby simple apprehension, via *noûs*, of the things apprehended is achieved. [*An. Po.* 100b3–15] So we become directly acquainted with these objects apprehended by induction. Then induction makes us able to apprehend and know abstract objects. The abstraction would have to serve a function other than enabling us to apprehend abstract objects, as indeed Cleary himself maintains.

Aristotle implies at 81b4–5 (whether we take the 'ὅτι' at 81b4 to indicate the reason or to indicate the content of what has become familiar to us) also that each genus has some of the things said by abstraction given by induction. An abstract object belongs to a genus not in the way that a separate thing, sc., an individual substance, does. Rather each belongs to one "*qua* each such thing," i.e., *qua* itself. [81b5] Thus number belongs to discrete *quantum* and to *quantum qua* number; likewise number belongs to two *qua* two, or to two *per se* (καθ' αὐτό), *qua* number.

Neither number (the genus) nor even individual numbers exist *in re* as separate substances. Still, we may legitimately treat them as if they were separate individuals and put them under a genus, so as to have a science of arithmetic.

Posterior Analytics I.18 does then give us strong grounds not to view abstraction as a merely psychological process. It also gives us strong grounds not to identify abstraction with induction. Yes it does not follow, as Cleary seems to say, that the induction is not a type of abstraction.¹⁰ It could be that induction is one application of a process of abstraction, where abstraction could have other applications. This text by itself does not resolve this issue. For instance, take induction as the process whereby the universals arise from the relevant singulars, and the abstraction proper, used to generate the abstract, proper objects of mathematics, as the process whereby universals inseparable *in re* in the individual substance and even *in intellectu* initially come to be treated as if they were separate. E.g., we might start off with individual physical objects and then via induction come to the general concept of body. Such a body would have color and shape (in general). Yet we may then “abstract” and treat the color and the shape as if they were separate, even though these universals necessarily go together. A non-rational animal could not make the final abstraction, Aristotle might say, although it can have experience and general notions (“primitive universals” as in *Phys.* 184a24–5; *An. Po.* 100a16) via some less ultimate processes of abstraction.

Again, should we agree with Cleary and translate ‘ἀφαίρεσις’ as ‘subtraction’? This translation has the advantage that we can see the parallel with ‘addition’ clearly. Cleary seems to dislike the use of ‘abstraction’ because it, like ‘extraction’, suggests that the item to be abstracted already lies there ready to hand, and needs be only plucked out, like a raisin in a pudding. Rather, we should understand ‘ἀφαίρεσις’ to indicate a process whereby we take the object and pare away, or subtract, attributes until we arrive at the abstract object desired.

I see several problems with this approach. First, as we do not know all the items to be subtracted, the analogy with mathematical subtraction breaks down. I can fix upon only the numerical or geometrical attributes to an individual substance by stipulating, ‘*qua* number’ or ‘*qua* shape’. I do not thereby list all the items to be subtracted and then see what is left. The process of subtraction generates two things, two numbers, the number subtracted and the remainder, each of which can be known determinately. In contrast abstraction generates one abstract object and an indefinite residue.¹¹ Aristotle makes a similar point about the process of defining. [97a6–7]

Again, taking the abstraction process as one of subtraction, or paring away, makes an individual substance something like an uncarved block, ready to be shaped

¹⁰ Cleary (1995: 488) agrees that abstraction/subtraction is not a third way of learning, in addition to demonstration and induction.

¹¹ Scaltsas (1994: 11–2, 34, 116) suggests that abstraction generates two objects. However he focuses on the abstraction of matter and form from a substance, and there we have a form, capable of definition, and, with the ultimate if not the proximate matter, an indefinite stuff. So unlike subtraction abstraction does not yield two equally definite things.

according to the whim of the sculptor.¹² Yet Aristotle seems to view the abstract objects apprehended to have a real basis in the individual substance. For science is of real beings. Remember that Aristotle holds that both individuals and universals exist *in re*. For he says that both the primary substances and the secondary substances, the universal substances, exist *in re*. To be sure, he does say that the existence of the latter depends upon the existence of the appropriate singular substances, which are primary. Still the universal substances exist nonetheless. Likewise, Aristotle admits that universal accidents exist. Apart from saying so in the *Categories*, Aristotle needs them in order to have science. For *propria* and *differentiae* are in accidental categories, and these *per se* accidents, along with substances, serve as the main items discussed in science.¹³

Consequently, the 'subtraction' interpretation has its problems too. Just as Aristotle appropriates many geometrical terms in his theory of syllogistic (like 'term' and 'figure') and demonstration, but uses them differently or at any rate extends their usage, so too he may be doing likewise in his use of 'ἀφαίρεσις'. I am inclined to admit that 'ἀφαίρεσις' does end up having the negative function or result of eliminating, or paring away, all those attributes that do not agree with the aspect specified. Yet we need not do this in advance. Rather, we subject the predications presented to a test, namely whether or not they agree with the aspect specified. Then, if they pass that test, we admit them into this particular scientific discourse; if they do not pass, then we eliminate or "subtract" them. However, unlike arithmetical subtraction, we need not specify, in advance or all at once, all the predications, all the items to be removed. We need only to look at those attributes of which we have come to be aware, and require that those that do not pass the test of relevance be excluded. We need not "subtract" all possible irrelevant attributes. Accordingly, I shall opt for the traditional translation of 'abstraction' for 'ἀφαίρεσις' to signify a process *sui generis*. Too, although we do not have the same problem, of not being able to specify all the objects to be added, perhaps it is best, to emphasize that the mathematical use has only a limited scope, also to translate 'πρόθεσις' not as 'addition' but as 'combination' or 'synthesis'.¹⁴

I do concede, however, that at times Aristotle does use 'ἀφαίρεσις' in the sense of mathematical subtraction. [E.g., 1061b20; 1023b13–5; 1024a27] Here we can indeed think of abstraction as removal. [Cf. (ps.) Alexander, in *Metaph.* 427, 18; *Simplicius*, in *Phys.* 496, 13–6] (Ps.) Alexander suggests that 'ἀφαίρεσις' means subtraction in the category of *quantum* strictly speaking but only metaphorically so in other categories. [in *Metaph.* 423, 36–9] Perhaps this is the solution. For the mathematical conception of subtraction applies in full force only to quantities. To avoid ambiguity I think it better not to have two uses of the same term, and so will continue to call the non-quantitative "subtraction" 'abstraction'.

¹²Lewis (1991: 286–7, 307) takes 'ἀφαίρεσις' as 'stripping off' as Descartes speaks of stripping off the attributes of the piece of wax in *Meditation* 2. He ends up calling this "selective inattention".

¹³On the status of *differentiae* and *propria*, see Bäck (2000: 151–8).

¹⁴Reeve (2000: 40) translates 'πρόθεσις' as "positing", with "abstraction" for 'ἀφαίρεσις'. But this seems too far removed from the mathematical background of the two terms.

2.3 Abstraction as Selective Attention

Abstraction is a powerful tool in mathematics; by concentrating only on certain essentials of a situation, and disregarding other aspects, one is free to pursue new results. (Ronan 2006: 9)

In order to mark off an abstract object, like ‘two’ or ‘number’, we must be able to specify the aspect that we wish to separate off. We specify an aspect like number so as to generate abstract objects. We then look at our sense perceptions, examine the phenomena, to see what content they have under this aspect. As Lear puts it, we “filter” our experience in order to get at what we have chosen to find relevant (Lear 1988: 23). We do not invent the phenomena, but can choose what we want to notice. Hence I suggest conceiving abstraction as selective attention.¹⁵

I agree with Zev Bechler that “Aristotle’s theory of...abstraction depends on an interpretation of his technical term...‘qua’” (Bechler 1995: 166).¹⁶ He objects to claiming that in a phrase of form ‘P qua M’, ‘qua M’ restricts the content of P to what it has in common with M. He says that “if qua is taken as a predicate filter there is the problem that ‘P qua M’ just gives you M and so already presupposes that M already preexists in its purity.” I do grant that talking of “P qua M” thus already presupposes that we have some grasp of what M is. But I submit that Aristotle has that problem: the common complaint about using abstraction to explain our knowledge of universals is that it begs the question: we must already know that in virtue of which the abstraction is to be performed in order to come up with the abstraction (Bertrand Russell, *The Problems of Philosophy*, Chap. 4). Still, I submit, that is Aristotle’s problem and not a fault of the interpretation. Moreover it is not an ontological but an epistemological problem. To anticipate, I shall claim that for Aristotle we do gain a rather fuzzy, inchoate acquaintance with universals via sense perception. As for the logical structure of the qua operator, it does a bit more than filter, when taken restrictively or abstractively. See Chap. 8 and the Appendix for more discussion (Bäck 1996: 3–83).

Construing abstraction as selective attention has the advantage of unifying the two different sorts of abstraction that Alain de Libera finds in Aristotle: (1) the sort in the mathematical sciences, of taking the form from the matter (in effect, what I have called ‘extraction’) and (2) subtracting as opposed to adding on attributes (de Libera 1999: 30). Selective attention performs both functions.

¹⁵Rollinger (1993: 13, n. 21) has likewise used ‘selective attention’ to characterize Meinong’s view, although not in the same sense. Studtmann (2002: 219) has noted that some scholars have taken Aristotle’s abstraction as selective attention. Annas (1976: 29–30) finds this vague, as Aristotle has no formal theory of abstraction. We shall see.

Bodéüs (2001: 124) defines *periaireo* as ‘to find a remainder while suppressing all the rest’; cf. *Metaphysics* 1029a11–2. This interpretation of Aristotle would make him fit in not too badly with work on perception and cognition in modern psychology. See, e.g., Ballard 1996: 116–9.

¹⁶Bechler (1995: 171) goes on to say that “...by qua as an abstraction operator Aristotle means an infinite, or absolute potentiality, construction.” (He gets this from the mathematical texts, where the items abstracted, like line and point, do not seem to exist in perceptible substances.)

Likewise, taking abstraction as selective attention provides a common basis for the different views about Aristotle's theory of mathematical objects distinguished by Mueller (1990: 464–5).¹⁷ It leaves open the question whether the *abstracta* are universal or singular (or some other option¹⁸). It allows for mathematical objects to be either *abstracta* of the physical objects themselves, as Lear and Cleary take them, or of certain features of extension as such, underlying physical objects, as in Mueller's view (Mueller 1979). For this pure extension itself would be an *abstractum*, on which we then perform another abstraction operation. Indeed, we can classify these different interpretations according to what the abstraction is performed upon and what features are being abstracted from.

Thinking of abstraction as selective attention has another advantage. For it gives the intellect, and even the sense organs, an active role in locating these structures in its sense experience: it must “attend” to those features. Still, as I shall stress below, selective attention need not be a self-conscious, deliberate process. View attention then as a sort of ‘aiming at’. Aristotle himself seems to have this sort of conception when he attributes ὄρεξις to all animals able to perceive and imagine. [*An.* 413b23] We can translate ὄρεξις as ‘desire’, but only ‘desire’ in a basic sense in which all animals can be said to “desire” food when they move towards a source of food. I mean ‘attention’ in the definition of ‘abstraction’ in this way too. Again, selectivity also need not imply any sort of deliberation or even of thought. Indeed, the sense organs themselves interact with the environment so as to be responsive to only certain types of stimuli as input. So they respond to stimuli “selectively” without any consciousness or choice being required.¹⁹ (Likewise in modern science particles “respond selectively” to different sorts and quanta of forces.) This interpretation will fit nicely with Aristotle's psychology, particularly with the recursive abstractions constituting the perceptual and cognitive processes.

As opposed to the modern empiricists, Aristotle does not view abstraction as a merely human psychological operation (Bechler 1995: 185). To be sure, he takes abstraction to be a psychological operation. Still for him psychological operations are just as real as other natural operations. So too Aristotle puts the particulars of perception and knowledge in the same category as colors and shapes: quality. For Aristotle we shall see abstraction naturalized. It is no mirror, reflecting nature while being outside of it. It is part of nature. It arises from certain interactions of a human organism with other parts of nature. Thus it will reflect the activity of other natural objects. It also has some special abilities of reflecting upon them. To this extent I can agree that Aristotle holds human mental experience is the mirror of

¹⁷ Likewise Detel (1993: 211–4) takes intelligible matter to be the spatial continuum.

¹⁸ As discussed above *re* types and tokens.

¹⁹ Of course, in the case of animals, certain types of selective attention may require consciousness. My conception of selective attention agrees with Caston 2002: 759: “...Aristotle cannot plausibly mean that animals are continually aware of such changes as a result of deliberately observing them and directing their intention towards them.” I.e., not introspection; rather: “not unaware” [*Phys.* 244b12–245a2; cf. 437a26–9; 447a15–7] in “an unobtrusive way”. Also Wedin 1993: 153: “...an object is suitable for consideration in abstraction only if there is no such object, but we nevertheless have some idea of what such an object would be like.” Cf. Wedin 1989.

nature: as it is a part of nature, it will reflect, and reflect upon, other natural phenomena (Rorty 1979: 38–41).

John N. Martin claims that in antiquity ‘abstraction’ (‘ἀφαίρεσις’) in the general sense has two aspects: it conserves something while taking something else away. He goes on to claim that ‘ἀφαίρεσις’ came to acquire two special meanings: roughly, one Aristotelian and one Platonist: the former consisting in the process of subtraction, or, as I prefer to think of it, in selective attention; the latter in the inverse relation of construction.

Martin takes Aristotle to have a specialized sense of abstraction as concept formation, which is vaguer than the general one, as Aristotle has no theory of conceptual abstraction.²⁰ However, he says, Porphyry and Boethius made the process explicit. I would say that that Aristotle’s commentators were merely restating his views—as Martin himself goes on to imply. Moreover, so I shall be arguing, Aristotle takes both mathematical abstraction and conceptual abstraction as different applications of the abstraction operation, for which Aristotle does offer a theory.

Martin claims that Plotinus and Proclus, following the Pythagoreans and Plato, have a different, special sense of ‘ἀφαίρεσις’. In their ontology they construct the more complex things from the more basic ones, ultimately the One, by *adding* features on to it (Martin 2004: xi–xiii, 37–9). Martin holds that going in reverse, so as to break down composites would be ἀφαίρεσις as “subtraction”.

Abstraction is the epistemic converse of the process of physical composition...the mental process of reversion to the One. Ontologically, the Chain of Being proceeds downwards through the process of causation, but the Understanding remounts backwards from the bottom to the top. The process of remotion is called abstraction. (Martin 2004: 163)

Martin does not want to attribute the mathematical or Aristotelian sense of abstraction to Plotinus on account of the standard Hegelian complaint that then the One, arrived at via abstraction, would have less content than the beings emanating from it (Martin 2004: 40, 115 n. 58). Rather, the One is the set of all things, with the things emanating from it its “smaller effect sets” (Martin 2004: 45).

I see some problems with Martin’s claim that the Platonists had another conception of ἀφαίρεσις. First, he offers little textual support in favor of this view *re* the occurrences of ‘ἀφαίρεσις’. What textual support there is can be explained by the general, mathematical use of ‘ἀφαίρεσις’, common to both Platonists and Aristotelians, where ‘ἀφαίρεσις’ just means subtraction, contrasted with addition. It’s just that what is left for the Platonists once the differentiations and divisions of the lower genera are removed is a whole or One embracing them all. Moreover, ‘ἀνάλυσις’ in the *Prior Analytics* etc. seems to mean what Martin is taking ‘ἀφαίρεσις’ to mean. Alexander of Aphrodisias says that “analysis is the rendering of every composite into its highest principles, and is the way back to the highest principles from the last conclusions.” [*in An. Pr.* 7, 14–8] Second, Martin gives a

²⁰ So too Spruyt 2004: 126–7.

false etymology for ‘ἀφαιρέω’: as coming from ‘φέρω’, while in fact it comes from ‘αἰρέω’ ‘to take’ or ‘to choose’ (Martin 2004: xiii n. 8).

Coniglione (2004: 70–80) has a much more convincing account of the difference between Platonist and Aristotelian abstraction: Unlike Aristotle, Plato did not derive universals as common elements from perceptions of individuals. For Plato abstraction is the process of leaving out all the imperfections of the exemplars of Forms and ascending to the Forms themselves. [*Resp.* 525c] Abstraction thus becomes a purifying, intellectual process for apprehending Forms via being reminded of them by sense perception. The Forms themselves are causal principles governing the behavior of their instances. In contrast, Aristotle denies that mathematics can be applied to astronomy. [Cf. *Metaph.* 997b] In the modern period, scientists like Galileo, Descartes and Newton returned to Platonism when they constructed idealized objects like point masses and frictionless bodies by which to formulate laws of nature.²¹ “Only by creating fictitious, ideal entities and then descending from them by means of experiment and approximation to the “roughness of experience” is it possible to combine mathematics and reality” (Coniglione 2004: 72). Later philosophers took up this conception: Descartes and Leibniz (despite their protests), Cassirer (1923: 83), Lotze (1880: 151–2),²² Husserl (1970b).²³

On Coniglione’s account Aristotle and Plato do not have difference conceptions of abstraction proper. In both cases we have selective attention: some things are selected; others omitted. Rather, they differ in what they take to be the results of the abstraction process: on the one hand, universals; on the other, reminders of universals.

Despite the differences between Platonic and Aristotelian uses of abstraction, we can find both uses of ‘abstraction’ in Aristotle anyway. Abstraction as selective attention concerns the process whereby the *abstracta* are generated; the *abstracta* themselves are “ideal objects”. As we shall see, in constructing a universal, Aristotle at best has to go with what holds for the most part, and ignore *im-perfections* etc. He comes up with his universal species, genera, properties, principles from what holds for the most part. Somehow Aristotle gets to perfect geometrical shapes and lines, which have no instances in the actual things *in re* (Mueller 1979: 465). [Alexander, in *Metaph.* 52, 15–25]

When we look in detail, so far as possible, at how Aristotle views universals to be constructed, we shall then find Aristotle having a view of abstraction as selective attention where the content is somewhat idealized: its imperfections stripped away. Later Aristotelians tended to do that too.²⁴ Accordingly Lear claims that, when a proof holds of some object ‘as a triangle’ for Aristotle, it holds for one that is perfectly triangular not for it “more or less” (Lear 1988: 242). This switches the sense of ‘*qua*’ from his original conditions—and makes him agree more with Plato.

²¹ Cf. McMullin 1985; Funkenstein 1986: 89.

²² Cf. Coniglione 2004: 81–2; Rollinger 2004: 151–2.

²³ Trans. Findlay 1970 II.

²⁴ E.g., Avicenna, *Al-Ibāra* 16, 3–10; Aquinas *ST* I.85.1. Frede 2001: 177: “Abstraction, so Aquinas explains, means to inspect whatever is part of the thing in question without looking at individual features that do not belong to the essence of that thing.”

Mathematics and even biology deal with objects where we focus on idealized, typical cases and ignore the imperfections and monstrosities.

Let me close by mentioning other conceptions of abstraction current today, so as to make Aristotle's views clearer by contrast. I have already mentioned the modern empiricist way, of using abstraction pretty much like Aristotle except for restricting it to the psychological and withholding it from the ontological.²⁵

Some consider Locke a transitional figure. The selective attention arising when we consider common general features of the objects comes from properties of the objects themselves. The mind is just registering and recording them as universal ideas.²⁶ But Locke seems to take the mind as doing some selecting and editing on its own. Winkler then charges that Locke is violating what Winkler calls "the content assumption": "the content of thought is determined by its object" (Winkler 1989: 39–41). For instance, Locke wants there to be a general idea of man or triangle (*Essays* II.11.9; III.3.6; III.3.9). But there isn't one in nature; it must be imagined in the mind, apart from the particular images or ideas of triangles or men (Winkler 1989: 23–4). Hence general ideas must be produced via some sort of mental invention.

Berkeley takes abstraction to be selective attention in terms of the mind doing the selecting on the basis of what it wants to look at—perhaps for pragmatic or social reasons just as much as for scientific ones (Flage 1987: 35; Winkler 1989: 42). Winkler claims that Berkeley has two conceptions of selective attention (1) the contemplative: the intellect fixes its attention on certain features in its experience and ignores others (2) and the behavioral: by conversation: talking about some features of a man and not others; or by demonstration: using some features of the object in the demonstration and not others (Winkler 1989: 86–8). In either case, the abstractions produced need not reflect what exists *in re*. Theory based on such abstractions may be merely heuristic, a mere model. In contrast, Aristotle wants more realistic abstractions, representing real structures.

The rationalists differ from the empiricists in holding that innate ideas, as opposed to sense experience, make abstraction of the universal from particulars possible (Winkler 1989: 69). Still, to some degree, the mind is operating on the sensory content and not recording its general features passively. As we shall see in Chap. 6, Aristotle perhaps would agree.

Another usage, common to empiricists and rationalists, distinguishes 'abstraction' from 'exclusion'. Thus Descartes says:

²⁵ Thus, for instance according to Priest (2006: 73) abstraction occurs when "the factors which are deemed to be of central importance are selected out ... other factors which are of no or of only secondary importance are ignored."

²⁶ Mackie (1976: 107–12) and Taylor (1978) argue that Locke takes abstraction to be selective attention. Cf. *Essays* II.13.13. Winkler (1989: 40–1) claims that Locke does not connect up selective attention with abstraction. Donald Baxter (1997: 314–5) takes Locke, Berkeley and Hume to remove properties to get an idea in abstraction. But see his n. 59 & 328–9 where Baxter cites many who take Locke to have a view of selective attention. Baxter attributes that to Berkeley but not to Locke.

There is a great difference between abstraction and exclusion. If I said simply that the idea of which I have of my soul does not represent it to me as being dependent on the body and identified with it, this would be merely an abstraction, from which I could form only a negative argument that would be unsound. But I say that the idea represents to me as a substance that can exist even though everything belonging to the body be excluded from it, from which I form a positive argument, and conclude that it can exist without the body. ("Letter to [Mesland]," May 2, 1644 [AT, Vol. IV, p. 120; CSM, p. 236]; "Letter to Cleselier," Jan. 12, 1646 [AT, Vol. IV, pp. 357–8; *Principles* I.53])²⁷

Both abstraction and exclusion agree with Aristotle's conception of abstraction. Descartes distinguishes the two in terms of the sort of objects produced by the abstraction operation: if the *abstracta* cannot exist as separate substances, the operation is "mere abstraction"; if they can, it is "exclusion", which I have called 'extraction' above. Generally, abstract objects for Aristotle do not exist independently from their bases as separate substances. Descartes has introduced 'exclusion' for "abstract" objects that are such separate substances, like souls once physical attributes are "excluded" from the conception of human beings. Some empiricists and later philosophers like Stout have similar views (Stout 1901–1902: 13).²⁸

Another, more modern usage, aggravating to and documented by Angelelli, makes 'abstract' amount to 'incorporeal' or 'universal': not existing in space-time (Angelelli 1984: 462; 2004: 18–25). This use seems to have its roots in the Platonist, idealized sense of 'abstraction'. However now it has lost the Platonism and has assumed, explicitly or implicitly, a materialism or a positivism. Thus the ideal objects, particularly those used in scientific theory, no longer are taken as more real than their exemplars, but rather are taken as mere shadows of them or as heuristic devices for our knowledge of them. All it would take to give 'abstract' this sense is for people to take the Platonist, idealizing usage of abstraction and to add on a materialist attitude that only physical singulars accessible to sense perception have reality in a robust sense.

Peirce has a way of reconciling these two uses. For him "abstraction" includes two processes, the "subjective", where an abstract noun is made from a predicate, and the "precisive", where a verb or predicate is generated from a noun by universalizing it. In a geometrical proof, the subjective is used to make the figure of a particular triangle from the general predicate, 'is a triangle', and the precisive then to generalize the conclusion made from that figure (Shin 2010: 41–58, 51; Peirce N3.917).

Frege has not only (1) the traditional, Aristotelian use of 'abstraction' but also two more (Angelelli 1984: 459, 2004: 17). (2) He suggests but finally rejects *definition*

²⁷ Cf. Skirry 2004; Flage 1987: 21; Winkler 1989: 37.

On the empiricist side: John Norris (1701–1704) says that when things are really distinct considering them separately is not abstraction. Abstraction is "the drawing away of a thing from its self." Isaac Watts (1725: 200) says that negative abstraction: consider things apart which can exist separately; precise abstraction: consider things apart which cannot exist separately. Thomas Reid (*Essays on the Intellectual Powers* V.vi) calls the separation of two singular qualities that appear together "abstraction strictly so called"; the latter "generalizing". Cf. Winkler 1989: 26–8.

²⁸ Cf. van der Schaar 2004: 208.

by *abstraction*. Here a term is introduced in the context of an equivalence relation, of the form of Hume's Law: if we have a relation ' $\Phi(\xi, \zeta)$ ' that is commutative and associative then we can write instead of it ' $\xi = \zeta$ '.²⁹ To use the classic example from the *Grundlagen*: the number of F's $\leftrightarrow$ the number of G's iff the F's and the G's are equinumerous (Frege 1953: 56). The point is that the term introduced, ' ξ ' or 'number', is completely uninterpreted. Its only content comes from this equivalence, the "definition by abstraction". So then we "look around" and see if we can use the term in some interpretation useful to us (Carnap 1956: 1, 117; Angelelli 1979: 108–23). Frege ended up rejecting this method because it leaves the term completely undefined for things that cannot be put into the equivalence. This is the Caesar problem: in the definition of 'number': as Caesar cannot be put into the relation of equinumerosity, it is left open whether Caesar is or is not a number. So we cannot rule out that Caesar is a number and hence whether we are right in our interpretation for 'number' when the domain is our ordinary world (Frege 1976; *Grundgesetze*, Vol. 1 §10; *Grundlagen*, §§55–6, 65).³⁰

Frege also discusses and ridicules (3) a "magical" sort of abstraction, where different things are made identical by abstracting away all their differences. He was objecting here to mathematicians like Cantor and Ballue, who wanted to generate a set of identical units to use as numbers (Hill 2004: 222–3, 234). Indeed he goes so far as to ridicule this sort of abstraction as a miraculous divine force, "Shiva", beyond the comprehension of ordinary mortals (Frege 1979: 69).

For Frege "ordinary abstraction" (1) consists in comparing objects with respect to their properties and taking the ones in which they agree so as to arrive at a concept under which all the individuals fall. "Now this concept has neither the properties abstracted from nor those common to" those individuals (Frege 1979: 71). Thus the concept 'female mammal' does not bear young or give milk, although the objects that are female mammals do.

In contrast, the "divine" abstraction (3) sticks to the level of the original individuals, but takes them now as stripped of some of those properties. Frege ridicules this sort of procedure often (Frege 1984a: 204–5). He criticizes Husserl for using a type of numerical abstraction that makes "things absolutely identical without changing them."³¹ But, Frege insists, this is possible only in "the washtub of the mind". He objects that "the way of considering an object, and the abstractions performed in the mind of a subject, seem to be being taken for qualities of the object" (Frege 1984c: 231). If we consider Jupiter, he says, as an isolated object, it still does not

²⁹ Quoted in Angelelli 1984: 458.

³⁰ Cf. Dummett 1981: 402: "Frege has laid down that the value-range of a function f is the same as that of a function g ...just in case f and g have the same value for every argument." Frege then says that this does not suffice "to determine uniquely the reference of every value-range term." "...for an object not given as a value-range, we have no means of deciding whether it is a value-range ..."

Frege's method of definition by abstraction is having a current renaissance though. Cf. K. Fine 2002; the articles by Fine and Wright in Schirn 1998; Wright 1983, 1997, 1999; Schirn 1996.

³¹ Husserl claims to base number on a type of abstraction different from Locke and Aristotle: we get concept of a number from taking a set of like elements and retaining each "only insofar as it is a something..." (Husserl 1970a: 88–92, 165–6; 1981: 16–7).

lose its shape, mass or gravitational relations. It would be silly he says to think that the mental act of abstraction creates a new object, an impoverished Jupiter if you like (Frege 1984c: 232). So too he writes,

By abstraction the logician acquires the concept pea, and to him it does not usually matter whether he has a handful more or less. The individual peas remain completely unchanged in the process and are not thereby transformed into the concept pea or replaced by it, but continue to exist beside it. The present process is much more marvelous: each individual pea divests itself entirely of its nature as a pea, but—and this is the most marvelous part—continues nevertheless to have a shadowy being separate from its fellow peas and without fusing with them. (Frege 1984b: 254)

Frege objects that the abstract peas, now stripped of all difference, have no right to claim any plurality of objects. Rather what is abstracted is the general concept of pea.

I have described Frege's views in some detail because they have some relevance to how we understand Aristotle. As we shall see, Aristotle insists that we are not creating transcendent, magical objects via abstraction. When the geometer abstracts from physical objects to consider them only as spheres and lines, she is not creating new individual substances, Aristotle says. Yet she is treating them "as if" they were independent substances. Moreover, the objects so considered are hypostasized so as to be subjects and not, as with Frege's reputable abstraction (1), unsaturated concepts of objects (in the formal language: predicate functions of individual constants). That is, unlike Frege, Aristotle allows for these *abstracta* to have properties of the same types as those that the original substances have. Thus not only is the Cube in Mecca cubical but so too is the cube studied in geometry. In contrast, Frege rejects Aristotle's antepredicamental rule, that the predicates of the predicates of an object are predicates of the object (Angelelli 1967: 52–3; Bäck 2000: 178–85). Frege holds that the predicates of an object are concepts, and their predicates are higher-order predicates not predicated of the object. Universals of the sort that Aristotle allows are objects formed by abstraction. Like Frege, Aristotle will reject the magical abstractions (3) leading us to Plato's transcendent Forms. Yet, by ending up with objects and not concepts, Aristotle might have become a bit too magical for Frege's taste. But now we need to see how Aristotle works his magic.

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