

# A Complementary Approach to Aristotle's Account of *Definition* and Carnap's Account of *Explication*<sup>[\*]</sup>

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## Abstract

[19] In this paper it is argued that there are relevant similarities of Aristotle's account of definition and Carnap's account of explication. To show this, first, Aristotle's conditions of adequacy for definitions are provided and an outline of the main critique put forward against Aristotle's account of definition is given. Subsequently, Carnap's conditions of adequacy for explications are presented and discussed. It is shown that Aristotle's conditions of extensional correctness can be interpreted against the backdrop of Carnap's condition of similarity once one skips Aristotelian essentialism and takes in a Carnapian and more pragmatic stance. Finally, it is argued that, in general, a complementary rational reconstruction of both approaches allows for resolving problems of interpretational underdetermination.

**Keywords:** definitions, essentialism, explications, Aristotle, Carnap

## 1 Introduction

*Analysis* is considered to be at the heart of philosophical methodology, particularly of analytic philosophy. Although, at first glance, this seems to be a unifying feature, it is clear that there are many different ways in which people understand and still understand this notion. Beaney (2013, sect.1.1) distinguishes three important forms of analysis. Firstly, there is *regressive analysis* which consists in working back from something to be analysed to something more fundamental by means of which it can be established. A typical case of such an analysis is finding some fundamental principles or axioms on the basis of desiderata or constraints. Secondly, there is *decompositional analysis* which

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consists in “breaking a concept down” into less complex parts, so that its underlying structure is revealed. Examples of this form of analysis are Plato’s *dihairesis* (method of division) and Aristotle’s account of *real definition*. And, finally, there is *transformative analysis*, which is the translation of a notion of one system or language to a notion of another system or language. Typical cases of such an analysis are formalisation, but also explication.

In this paper we outline what we take to be the *communis opinio* Aristotle’s on conditions of adequacy of definitions (i.e. ways of performing a decompositional analysis) and explications (i.e. ways of performing transformative analysis) as proposed in the methodology of Rudolf Carnap. As is well known, Aristotle considered it to be the main purpose of definitions to mark the essence of things, whereas Carnap marked explication as an important methodological framework for definitions. Our main aim is to highlight the most relevant similarities and dissimilarities of both approaches. We argue that understanding both forms of analysis in a complementary way fares well in the sense that it avoids some of the problems that were put forward against these accounts. The main [20] idea is that interpreting Aristotle’s account of definitions against the backdrop of Carnap’s conditions of adequacy for explications allows for a much more pragmatic (purpose-dependent) reading and circumvents problems of Aristotle’s account that arose in course of an increasing criticism of essentialism. On the other hand, Aristotle’s account (interpreted this way) allows for embedding Carnap’s approach into a much wider tradition and provides an illustrative example for some of the Carnapian conditions of adequacy likewise, as Aristotle’s syllogistic still serves illustrative purposes in the didactics of modern predicate logic.

The structure of the paper is as follows: In section 2, we outline the main elements of Aristotle’s theory of definition and its conditions of adequacy. In section 3, we present the main critique put forward against it and sketch how this paved the way for new forms of definitional analysis. Section 4 provides a detailed discussion of one such new form, namely explication as championed by Carnap. In section 5, we compare the conditions of adequacy for definitional analysis of Aristotle and Carnap and stress important similarities, but also dissimilarities between them. We briefly conclude in section 6.

## 2 Aristotle’s Theory of Definition

Aristotle (384–322 BC) can be considered to be the founding father and—in view of the impact and length of the period of influence of his work—most important author in the domain of formal logic. But also with respect to definitions his account was authoritative. After rediscovering his work, his logic and theory of definition was collected and bundled in the so-called *Organon* (ancient Greek, Engl. *instrument, tool*) Aristotle’s investigations of definitions are to be found mainly in the *Analytica posteriora* and the *Topica* of the *Organon* as well as in his *Metaphysica*. In the *Topica*, he characterises definitions as demarcations by help of a *genus* and *differentia*. The exact wording is as follows

(*Topica*, book I, chapter 8, Bekker-reference 103b—(cf. Aristotle 1960, pp.292f, trans. Pickard-Cambridge)):

“The definition consists of genus and differentiae.”

According to Aristotle, the main purpose of definitions is to name the *essence* (ancient Greek: ‘*to ti ên einai*’) of a phenomenon in question (*Topica*, book VII, chapter 5, 154a—(cf. Aristotle 1960, pp.666f, trans. Pickard-Cambridge)):

“A definition is a description which signifies the essence (τὸ τί ἦν εἶναι) of a thing.”

This general characterisation allows us already to better demarcate our discussion of “Aristotle’s theory of definition”: Deslauriers (2007, p.1) describes Aristotle’s different treatments of definitions as follows:

“In the *Topics* Aristotle’s concern is to set out guidelines for the construction of definitions and the testing of definitions in the context of dialectical discussions. In the *Posterior Analytics* his concern is to describe the role of definition in demonstrative syllogism. In the *Metaphysics*, his concern is to make clear certain features of essence [...].”

We rely mainly on Deslauriers (2007) for our presentation. It focusses on the guidelines for adequate definitions (*Topica*) and connects only very remotely to questions of essence (*Metaphysica*—according to Deslauriers (2007, p.84) there exists an important connection in this respect via so-called *immediate definitions* that state the *formal cause*) and explanation/demonstration (*Analytica posteriora*—Deslauriers (2007, p.5 and pp.53ff) sees a connection in the sense that both demonstration as well as definition involve a “complete *aitia* of some sort”).

[21] Since the definition of a notion (*X*) consists in a *genus proximum* (*G*) and a *differentiam specificam* (*D*), it has the form:

*X* is a *G* which is a *D*.

In order for such a statement to count for a definition, it must satisfy two criteria—it needs to be essential and “fully” substitutable:

“Every predicate of a subject must of necessity be either convertible with its subject or not: and if it is convertible, [... and] it signifies the essence, it is the definition.” (*Topica* book I.8, 103b7-8, trans. Pickard-Cambridge)

We can explicate the two criteria of signifying the essence and being convertible as follows:

- *GD* is the essence of *X*. I.e.: By necessity it holds: *X* is a *G* which is a *D*. I.e.: By necessity it holds that *x* is *X* if *x* is a *GD* (the modal interpretation of essences is to be found, e.g., in *Topica* book I.5, 102b5ff).

- Substitutability *salva veritate*: There is no proposition  $\phi$  such that  $\phi[X]$  is true ( $X$  occurs in  $\phi$  and  $\phi[X]$  is the case), whereas  $\phi[X/GD]$  is false ( $GD$  is substituted for  $X$  in  $\phi[X]$  and the resulting proposition is false; this is our interpretation of Aristotle's claim that in a definition a property is "correctly stated" in the sense that the predicate is convertible with the subject—cf. *Topica* book V.3, 132a7, trans. Pickard-Cambridge).

Here we need to mention that, strictly speaking, the term *convertible* used by Aristotle is more complex than simply guaranteeing substitutability *salva veritate*. For him two (simple or complex) predicates  $X$  and  $GD$  are *convertible*, if they are substitutable *and* there is no middle term linking them such that the definition " $X$  is a  $GD$ ." comes out to be the conclusion of a demonstration (cf. Aristotle 1957, *Analytica posteriora*, 94a10). We think that in our characterisation the assumption that  $G$  is *the* genus of  $X$  already rules out that there is such a middle term, and hence we think that this additional constraint for *convertibility* is already captured by the assumption that  $G$  is the genus of  $X$ . However, as we will see below, when we come to conditions of adequacy for definitions this exclusion of a "middle term" will be more or less explicitly taken into account by asking for the correct *locus*. The substitutability *salva veritate* constraint will be more or less explicitly covered by the conditions of extensional correctness (neither being too narrow nor too wide). Also, we need to mention that this criterion is not implied by the first one, since, e.g. "partial" ascriptions of essential properties satisfy (i), but not (ii).

Given this characterisation, Aristotle goes on to discuss their conditions of adequacy (Aristotle 1995, *Topica*, book VI, 139a, p.524, trans. Pickard-Cambridge):

"The discussion of definitions falls into five parts.

- [A1] For you have to show either that it is not true at all to apply the account to that to which the name is applied (for the definition of man ought to be true of every man);
- [A2] Or that though the object has a genus, he has failed to put the object defined into the genus, or to put it into the appropriate genus (for the framer of a definition should first place the object in its genus, and then append its differences; for of the elements of the definition the genus seems to be the principal mark of the substance of what is defined); [22]
- [A3] Or that the account is not proper to the object (for, as we said above as well, a definition ought to be proper);
- [A4] Or else see if, though he has observed all the aforesaid cautions, he has yet failed to define the object, that is, to express the essence of what is being defined.
- [A5] It remains, apart from the foregoing, to see if he has defined it, but defined it incorrectly. [... (139b p.525):] Incorrectness falls

into two branches: first, the use of obscure language (for the language of a definition ought to be the very clearest possible, seeing that the purpose of rendering it is to make something known); secondly, if the account is longer than is necessary (for all additional matter in a definition is superfluous)."

We can give these statements a reading which is common in modern investigations of definitions: A definition has the form 'X is a G which is a D.' and has to satisfy the following conditions of adequacy (cf., e.g., Chakrabarti 1995, pp.13f for a systematical; Kutschera 1967, sect.6.3.1 for a logical; and Robinson 1950, V., §10 for a definition-theoretical context spanning over these conditions):

Ad A1: **Not too narrow:** For all  $x$ : If  $x$  is an  $X$ , then  $x$  is also a  $GD$ .

Ad A2: **Correct locus:**  $G$  is de facto the next systematic upper category (*genus*) of  $X$ .

Ad A3: **Not too wide:** For all  $x$ : If  $x$  is a  $GD$ , then  $x$  is also an  $X$ .

Ad A4: **Essentialistic:** By necessity it holds that for all  $x$ :  $x$  is  $X$  iff  $x$  is a  $GD$ .

Ad A5: **Clear and relevant:** "Incorrectness falls into two branches: first, the use of obscure language [...]; secondly, if the account is longer than is necessary" (*Topica*, book VI, chapter 1, 139b—(Aristotle 1995, p.525))

In the scholastic tradition, but also before and by Aristotle himself several other rules for adequate definitions were put forward (cf., e.g., the brief discussion in Suppes 1957, §8.1). Well-known is, e.g., the rule that a definition must not be in the negative when it can be in the positive (cf. *Topica* VI.6, 143b11-144a4) which follows from the form 'X is a G which is a D.'. Also well-known is the so-called *rule of non-circularity*: A definition must not be circular; this rule follows from the condition of the correct *locus* since a notion's *genus proximum* cannot have the notion as a *genus proximum* itself. We restrict our considerations to conditions A1–A5, since they are independent of each other, they found their way into the definition theoretical canon or were explicitly excluded from it (Dubislav 1981), and they fit neatly into Aristotle's general approach to logic and philosophy of science (for a discussion of the role of definitions in his philosophy of science, cf. particularly Weingartner 1976, sect.3.8252, pp.246–253; and Weingartner 1991).

Now, these conditions can be also graphically represented by help of *Venn diagrams*. Figure 1 provides such a graphical representation.

Schema 1 of figure 1 describes the adequate characterisation where the *genus* is the *genus proximum* ( $G$ ), the *differentiam* is the *differentiam specificam* ( $D$ ), and both, i.e. their cut, represent exactly the notion to be defined ( $X$ ). In schema 2 only a part of the  $X$ s is covered by  $GD$  for which reason the definition is too narrow (e.g., when one characterises *man* as a *rational white-skinned animal*). In schema 3, on the other side, more than just  $X$  is covered by  $GD$ ,

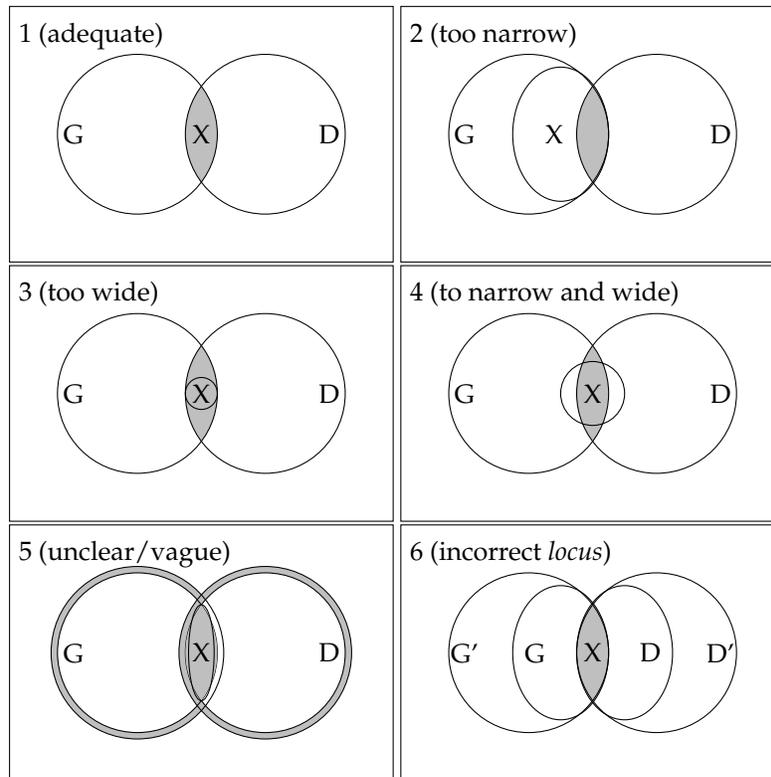


Figure 1: Venn diagrams to possible problems of a definition of  $X$  by help of a genus  $G$  and a differentia  $D$

for which reason the definition is too wide (e.g., when one characterises *man* as a *two-footed animal*). Schema 4 depicts the case where neither  $X$  is completely covered by  $GD$ , nor only  $X$ , hence this is a case of a too narrow and too wide definition (e.g., when one characterises *man* as a *two-footed white-skinned animal*). In schema 5 the boundaries of  $G$  or/and  $D$  are vague for which reason also their cut is vague and hence it is unclear/vague [23] whether  $X$  is adequately characterised or not (e.g., when one characterises *population* as a *collection of humans*, assuming that in this context it is vague what is meant with a *collection*—constitutes a single person a collection? two?, etc.). Finally, schema 6 considers the case of an incorrect *locus* by the choice of some genus  $G'$  and differentia  $D'$  which together single out  $X$ , but they do so by crossing the systematic (background ontological) hierarchy (e.g., when one characterises *man* as a *finitely rational being*). For a discussion of the essentialism-requirement (condition A4) the schemata need to be interpreted modally: If in all possible worlds schema 1 holds, then  $GD$  grasps the essence of  $X$ . If in at least one

possible world schema 2, 3 or 4 holds, then *GD* does not grasp the essence of *X* (e.g., although *animal having a heart* and *animal having a kidney* are in fact co-extensional, we can think of worlds where these notions deviate from each other). If, furthermore, in the actual world schema 1 applies, then *GD* provides a *proprium* of *X*.

We consider these conditions to be the core of Aristotle's theory of definition which influenced philosophical inquiry for more than 1.5 millenia. In the next section we outline the main critique put forward against it and indicate how this allowed for focusing on other forms of definition.

### 3 The Main Critique on Aristotle's Account and its Shift Towards the Modern Theory

Let us discuss now the main critique on Aristotle's theory of definition which paved the way for the modern theory of definitions. What is widely uncontested are his requirements regarding extensional correctness, clarity, and relevance: Most modern theories and characterisations of definitions consider it to be one important condition of adequacy for definitions that they are appropriate with respect to the intended notion, namely that a definition should be neither too narrow, nor too wide (A1 and A3). Similarly, they simply take over the condition of clarity and relevance (A5). Well-known is, e.g., the generalisation of the scholastic William of Ockham (1288–1347) who transformed the relevance requirement to a requirement for explanatory and ontological parsimony (Ockham's so-called *razor*). However, heavy critique was put forward particularly against the requirement of finding the correct *locus* (A2), and, subsequently, the requirement of providing the essence of the thing to be defined (A4).

Against the requirement of finding the correct *locus* when choosing a *genus* and *differentiam* already Gottfried Wilhelm Leibniz (1646–1716) argued that exact criteria of such a choice are unclear (cf. Leibniz 1896, p.313). Gottlob Frege had taken up Leibniz' critique and described it in such a way that we can display the problem by help of a Venn diagram again. [24] As one can see by help of schema 1 of figure 1, *X* can be characterised also by exchanging *G* and *D*: As a *genus* of *human* one could also take *rational capacity* and as *differentiam* one could take *animal*. It does not matter whether we start with *G* and cut it with *D* or whether we start with *D* and cut it with *G*. Figure 2 illustrates this problem.

Not only this formal objection against the correct choice of a *genus proximum* and a *differentiam specificam* was put forward. More generally, also the background assumption of a hierarchical ontology was considered to be implausible (such a critique can be ascribed, e.g., to Locke 1690/1999, book III, chpt.VI, par.30).

In the same metaphysical-averse direction, but much more powerful, was the critique against the requirement of definitions as grasping the essence of a thing or notion. In antiquity (with the exception of the sceptics) until scholas-

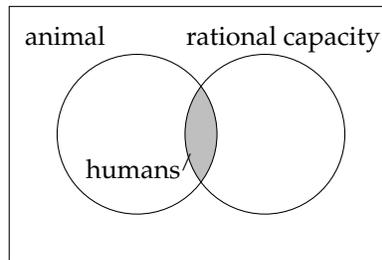


Figure 2: Example illustrating exchangeability of *genus* and *differentiam*: Are humans animals which have a rational capacity or are they beings with rational capacity that are animals?

ticism it was common practice to assume that entities have essential parts. However, particularly with the rise of the modern era this assumption was considered to be of less importance—not always in the realm of metaphysics, but more and more in the context of investigations of philosophy of language, logic, and the theory of definitions. So, e.g., scholastic authors still stressed the importance of characterising the *essence* by help of a definition (cf. Eisler 1904, “Definition”):

- Albertus Magnus (about 1200–1280)  
“Definitio indicat esse rei et essentiam.”  
I.e.: A definition shows the existence and essence of a thing. (*Summa Theologiae* l.c. II, 6, 1, trans. CFE)
- Thomas Aquinas (1225–1274)  
“Definitio indicat rei quidditatem et essentiam.”  
I.e.: Definition exhibits the “what” [the “what it is”] or essence of a thing. (*Summa Theologiae* II-II, 4, 1 c, trans. A.M. Fairweather: (Thomas Aquinas 1274/2006, p.263))
- William of Ockham (about 1285–1347)  
“Definitio exprimens quid rei.”  
I.e.: A definition expresses what a thing is. (*Summa Logicae* I, 26&29, trans. Michael J. Loux: (William of Ockham 1323/1974, pp.105&110))

Also in the modern era one can find repetitions of this requirement. So, e.g., Baruch de Spinoza (1632–1677) and also later authors put forward this requirement (for an overview cf., e.g., Robinson 1950, VI., §0). However, one also finds in the modern era the trend of a much more pragmatic stance (in the sense that essentialist considerations are replaced by simple stipulations and fruitfulness-considerations) towards definitions which might be ascribed particularly to a resettlement of definition theoretical investigations to other disciplines like mathematics. So, we find, e.g., the following claims in authors of the modern era: [25]

- Thomas Hobbes (1588–1679)  
According to Hobbes, definitions provide simply an arbitrary (pragmatic) mapping of expressions to objects. Since truths are to be derived by help of definitions, Hobbes is confronted also with the paradox of arbitrary truths, the problem that truth being conventional or arbitrary (this is considered to be an early version of problems of epistemic conventionalism in the form of assuming that in general propositions are not simply true or false, but true or false with respect to some convention)—Leibniz’ answer to this objection is discussed below (although this view is attributed to Hobbes, a direct reference to Hobbes is, also according to Robinson 1950, p.65, unknown).
- Blaise Pascal (1623–1662)  
“In geometry, only those definitions are recognised which logicians call nominal definitions, i.e, the simple allocation of names to things which have been clearly determined in perfectly known terms. I am referring only to these definitions. Their usefulness and application consists in clarifying and shortening discourse, by expressing, by the one given name, that which could only be expressed by several terms;” (Pascal 1657/2000, p.97) Here we see an explicit statement on definitions being particularly relevant for the purpose of short expression, without any demand of providing some essential characteristics, etc.
- Gottfried Wilhelm Leibniz (1646–1716):  
For Leibniz, the composition of a definition is arbitrary—cf. for example his argument against the choice of a *genus proximum* from above. In this sense, what and how we define depends on pragmatic factors of what suits our ends best. However, although our definitions are to a great deal arbitrary, whether an object with the properties assumed in a definition exists or not is not arbitrary. To note in passing, from a pragmatic standpoint, definitions are conventions and, hence, the problem of conventionalism and truth as indicated above showed up also for Leibniz. In order to address it, he differentiated between *nominal*, *real* and *causal* definitions (more on this distinction see below). According to him, in nominal definitions the assumption about such existing objects is left open; in real definitions it is proven possibly by help of a posteriori principles; and in causal definitions the existence of objects is proven by a priori principles alone. The paradox of arbitrary truths which Hobbes faced is resolved by Leibniz’ reference to causal definitions: since they are not arbitrary, also truths derived from them are not arbitrary (cf. Leibniz 1679/2000, p.150).

This increasing pragmatic tendency did not simply lead to a disinterest in the essence requirement of Aristotle (A4). Rather, more and more critique was put forward against it which culminated into the so-called *essentialism critique* of the twentieth century. So, e.g., Willard van Orman Quine influentially stated that “to defend Aristotelian essentialism, however, is not part of my plan. Such a philosophy is as unreasonable by my lights as it is by Carnap’s or Lewis’s”

(Quine 1963, p.156). He criticised particularly the assumption that an entity has properties which are essential to it. Roughly summarised, he argued that we not only lack a metaphysical criterion for demarcating essential from accidental claims. He, and back then many of his colleagues, also thought that it is completely unclear how to make logical sense of predication with necessity.

The aforementioned critique of a missing demarcation criterion was taken up later on and directly related to definitions by Karl R. Popper. According to him it is an idiosyncratic defect of ordinary language which guides us to formulate essentialist questions and statements, although we have no real understanding of their semantics. The main problem are so-called 'What is x?' questions (cf. also Robinson 1950, p.155): [26]

"I reject all what-is questions: questions asking what a thing is, what is its essence, or its true nature. For we must give up the view, characteristic of essentialism, that in every single thing there is an essence, an inherent nature or principle (such as the spirit of wine in wine), which necessarily causes it to be what it is, and thus to act as it does. This animistic view explains nothing; but it has led essentialists (like Newton) to shun relational properties, such as gravity, and to believe, on grounds felt to be a priori valid, that a satisfactory explanation must be in terms of inherent properties (as opposed to relational properties)." (Popper 1979, p.195)

"I believe that 'What is?' or 'What are?'-questions or, in other words, all verbal or definitional questions, should be eliminated. 'What is?' or 'What are?'-questions I regard as pseudo-questions; they do not all seem to be so pseudo, but I do think they all are pseudo-questions. Questions such as, 'What is life?' or 'What is matter?' or 'What is mind?' or 'What is logic?' I think should not be asked. They are typically unfruitful questions." (Popper 1979, p.309)

Now, these critical stances (which we prominently find already in the modern era) led to a decrease of essentialist approaches to definitions and an increase of interest in more pragmatic considerations. Aristotle himself already distinguished between different types of definition. One type of definitions with which it is intended to characterise the essence of an entity or notion—this is the type of definitions we were concerned with when explicating Aristotle's account of definition above; and this is also the type Aristotle considered to be very important. Another Type of definitions is, according to Aristotle, "an account of what the name, or a different name-like account, signifies" (*Analytica posteriora*, book II, chapter 10, 93b—(cf. Aristotle 1995, p.350)). This type of definitions was considered by him as not very interesting, but concerns exactly the kind of definitions we subsume here under the "pragmatic" approach. The former were called by scholastic authors '*real definitions*', whereas the latter were called '*nominal definitions*'. Nominal definitions were further distinguished into

three subtypes, namely pure stipulations, pure lexical definitions, and mixed forms thereof. This leads us to the following, nowadays well-established, categorisation of definitions (cf. Robinson 1950; and Morscher 2017, chpts.13f):

- **Real definitions:** The Aristotelean essentialist definitions as discussed above where the essence of an entity or notion is characterised; conditions of adequacy are particularly conditions A1 and A3–A5.
- **Nominal definitions:** Those characterisations which stipulate or describe the meaning/use of an expression by help of the meaning/use of another expression (without reference to essences, etc.). There are three subtypes of this type of definitions:
  - **Pure Stipulation:** The meaning/use of an expression is stipulated independently of any established meaning/use of the expression.  
Example: The expression ‘alternative facts’ shall be used for all those reports that are broadcasted via *FOX-News*.
  - **Pure Reportive or Lexical Definition:** The meaning/use of an expression is descriptively characterised by help of linguistic means in the sense that by help of an empirical linguistic study one characterises which objects are denoted by the language users by help of which expressions and which expressions are used by them in a substitutable way, etc.  
Example: The expression ‘alternative facts’ is used by some people for all those reports that are broadcasted via *FOX-news*. [27]
  - **Mixed Form:** The meaning/use of an expression is stipulated based on some already established meaning/use of the expression.  
Example: The expression ‘fish’ shall be used for vertebrates living in water which are cold-blooded and have gills (in accordance with ordinary language usage it includes, e.g., trouts, but in contrast to it it excludes, e.g., wales and dolphins).

It is clear that the three subtypes of definitions have very different semantic conditions: Whereas pure stipulations—as we want to understand them here—are not true/false, but simply convenient/inconvenient for particular purposes, lexical definitions are simply true/false due to linguistic facts. Regarding mixed forms things are not that simple: They are neither simply true/false nor simply convenient/inconvenient. Rather, they are true/false in one aspect, namely with respect to an empirical/linguistic core, and they are convenient/inconvenient in another aspect, namely with respect to the stipulated purposes. In general it is considered that the most important or predominant account for such mixed forms is provided by Carnap’s account of explications. This leads us to a classification of definitions as provided in figure 3.

Now, we have argued here that particularly the critique of an essentialist requirement for definitions paved the way for the modern and more pragmatic

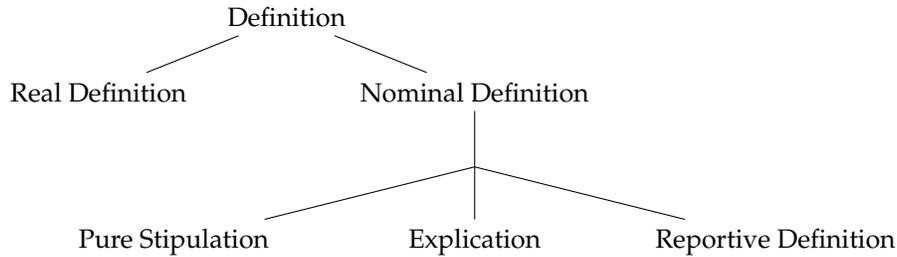


Figure 3: Basic classification of definitions

approach of definitions in form of nominal definitions. In the following section we discuss the most important mixed form of stipulative and reportive definitions, namely explications. In the subsequent section we will then highlight relevant similarities and dissimilarities between Aristotle’s and Carnap’s account of definitions and show that, after all, the latter can be considered in important respects to provide some continuation of the former.

## 4 Carnap’s Account of Explication

As we have seen above, particularly the twentieth century critique on essentialism increased the significance of nominal definitions, and an important form of nominal definitions are mixed forms containing a descriptive and a stipulative component. The most important mixed forms which found their way into the definition theoretical canon are explications as discussed by Carnap.

Before we go into detail, two remarks of precaution are in place. First, it is important to note that the notion of an *explication* is generally considered to have a much broader domain of application than that of definitions alone (cf., e.g. Carus 2007). However, since we are after comparing Aristotle’s and Carnap’s account of definitions, we restrict our investigation of explications in the following part to the domain of definitions. Second, there is a recent [28] interest in explications which brings to the fore that the traditional or so-called *extensional* approach to explication as outlined, e.g., by Hanna (1968) is too simplistic in order to adequately account for the several remarks of Carnap about explications (cf., e.g. Brun 2016, 2017; Dutilh Novaes and Reck 2017). However, we think that the traditional or extensional approach to explication has some intuitive and correct bearing regarding some prototypical cases in question, and it is these elements we want to focus on and employ for interpreting Aristotle’s account of definitions. Again, for better comparability we need to restrict comprehensiveness of the notion of *explication* under investigation and we think that it is reasonable to assume that, at least in several important cases (and particularly when it comes to interpreting Aristotle), explication can be adequately described within the extensional approach.

The main idea behind an explication is that one starts with a given meaning/use of an expression and aims to replace it by another meaning/use, whereby oftentimes the new meaning/use is “empirically motivated” in the sense that new discoveries might lead to a new conceptualisation (cf. Carnap 1959, p.14). Let us illustrate this by help of an example proposed by Carnap (1950/1962, §§2f):

- We start with our ordinary understanding/use of an expression of ordinary language like ‘fish’ which is in general used for any finned animal living in water. Let us call this meaning/use ‘fish<sup>A</sup>’. A linguistic study will show that this notion clearly applies to trouts and it clearly does not apply to humans (disregarding mythical creatures like mermaids). Regarding whales, dolphins, and eels, e.g., the linguistic intuitions might be not that clear. This could mean, e.g., that more than 90% of people apply ‘fish’ (in the sense of ‘fish<sup>A</sup>’) to trouts, less than 10% of people apply it to humans, and about 60% apply it to whales, whereas 35% do not apply it to whales and 5% remain undecided in this respect.
- Now, zoologists have found out that animals can be systematically ordered in such a way that important properties and relations apply particularly to cold-blooded vertebrates which have gills. Again, clear cases of this class are trouts, but also eels. And clear cases belonging not to this class are whales and dolphins. In order to describe these relations better, zoologists “re-engineered” the meaning/use of ‘fish’ in such a way that they apply it only to cases of cold-blooded vertebrates which have gills, thereby including, e.g., eels, but excluding, e.g., whales and dolphins. If we refer to this notion by help of ‘fish<sup>Ω</sup>’, then we can see that the notion *fish<sup>Ω</sup>* relevantly differs from the notion *fish<sup>A</sup>* (e.g. regarding eels, whales, and dolphins), however, it also coincides with it in relevant respects (e.g. regarding trouts, excluding humans, etc.).
- The expression ‘fish<sup>A</sup>’ is sometimes also called ‘*explicandum*’ (the expression to be explicated) and the expression ‘fish<sup>Ω</sup>’ is sometimes also called ‘*explicatum*’ (the resulting expression of the explication).

As we have stated above, explications are mixed forms of stipulative and reportive definitions. They are neither simply true/false nor simply convenient/inconvenient. In order to account for their adequacy, Carnap suggests the following conditions for explications (cf. Carnap 1950/1962, §3, p.7, 1959, p.15):

- [C]1 “[**Similarity:**] The explicatum is to be *similar to the explicandum* in such a way that, in most cases in which the explicandum has so far been used, the explicatum can be used; however, close similarity is not required, and considerable differences are permitted.

- [C]2 [**Exactness:**] The characterization of the explicatum, that is, the rules of its use (for instance, in the form of a definition), is to be given in an *exact* form, so as to introduce the explicatum into a well-connected system of scientific concepts. [29]
- [C]3 [**Fruitfulness:**] The explicatum is to be a *fruitful* concept, that is, useful for the formulation of many universal statements (empirical laws in the case of a nonlogical concept, logical theorems in the case of a logical concept).
- [C]4 [**Simplicity:**] The explicatum should be as *simple* as possible; this means as simple as the more important requirements (1), (2), and (3) permit.”

Analogously to the Venn diagrams for definitions in the account of Aristotle, we can also use such diagrams here to illustrate some of Carnap’s conditions of adequacy for explications, more particularly, conditions C1 and C2: We assume that, depending on a community of language users, every expression can be assigned to three kinds of extensions: A so-called *core extension*  $E_+$  which consists of the set of all objects to which the expression clearly applies according to the meaning/usage established in the language community. A so-called *counter extension*  $E_-$  which consists of the set of all objects to which the expression does clearly *not* apply according to the meaning/usage established in the language community. And a so-called *vagueness extension*  $E_0$  which consists of the set of all remaining objects to which the expression neither clearly applies, nor clearly fails to apply. So, e.g., regarding ‘fish<sup>A</sup>’, trouts are within its core extension, humans are within its counter extension, and eels are within its vagueness extension. Regarding ‘fish<sup>Ω</sup>’, the same holds except with respect to eels, which belong to its core extension too. Figure 4 illustrates the different extensions of a predicate.

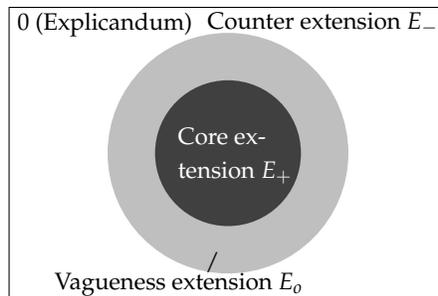


Figure 4: Extension of predicates: Core extension  $E_+$ , Counter extension  $E_-$ , and Vagueness extension  $E_0$

Now, according to the so-called *extensional* approach to explication, the similarity constraint (C1) can be *explicated* as follows (cf. Hanna 1968, p.36, conditions 1–3, our  $E_+/E_-/E_0$  amount to his  $P^+/P^-/D \setminus (P^+ \cup P^-)$ ):

- Ad **C1: Counter extensional correctness:** Every element of  $E_-$  of the explicandum is also an element of  $E_-$  of the explicatum. If we use ‘ $A$ ’ for the explicandum and ‘ $\Omega$ ’ for the explicatum, then we can express this condition as follows:

$$E_-^A \subseteq E_-^\Omega$$

- Ad **C1: Core extensional correctness:** Every element of  $E_+$  of the explicandum is also an element of  $E_+$  of the explicatum. With the same labelling convention from above we can state:

$$E_+^A \subseteq E_+^\Omega$$

[30] Regarding the exactness constraint (C2), Carnap demands that the explicatum is formulated in a more exact language than the explicandum is. Although the traditional debate focused on an explicandum in an ordinary language and an explicatum in a formal or scientific language, Carnap made clear that this has not always to be the case and that an explicatum of a pre-scientific language is also perfectly fine as long as its rules of application are clearer than that of the explicandum (cf. Carnap 1963, pp.933ff). Although there might be no direct bearing of the exactness constraint on the extensions in question, we think that there is at least some weak indirect bearing in the following sense: The more explicit, clear, and exact the rules of application are, the less vague cases there will be. Hence, we suggest to explicate an important feature of the exactness constraint via the following condition:

- Ad **C2: Reduced vagueness extension:**  $E_o$  of the explicatum is only a subset of  $E_o$  of the explicandum. Again, with the same labelling convention from above we get:

$$E_o^\Omega \subset E_o^A$$

These two partial explications (of C1 and C2) allow us already to account for the fact that explications are neither simply true/false nor simply convenient/inconvenient: We can say that an explication starting from an  $A$ -predicate and resulting in an  $\Omega$ -predicate is true, if it satisfies the conditions of counter- and core extensional correctness ( $E_-^A \subseteq E_-^\Omega$  and  $E_+^A \subseteq E_+^\Omega$ ). Otherwise it is false. And, given a general purpose of conceptual clarity, we can say that it is convenient with respect to this purpose, if it satisfies the condition of a reduced vagueness extension ( $E_o^\Omega \subset E_o^A$ ). This is, however, not the only way of being convenient (below we will even see that exactness might get in tension with other purposes and, hence, might be inconvenient in this respect). Other forms of convenience enter the scenery with the fruitfulness and the simplicity constraint, as we will briefly discuss below. For the moment it suffices to highlight that, according to a rough schema, truth/falsity, i.e. the descriptive component of an explication, is accounted for by the counter- and the core extension. And convenience/inconvenience, i.e. the stipulative component of an explication, is at least partly accounted for by the vagueness extension. By

this it should be clear that all four combinations of semantical/pragmatical values of an explication can be instantiated: there are (1) true and convenient explications, (2) true, but inconvenient explications, (3) false, but convenient explications, and (4) false as well as inconvenient explications.

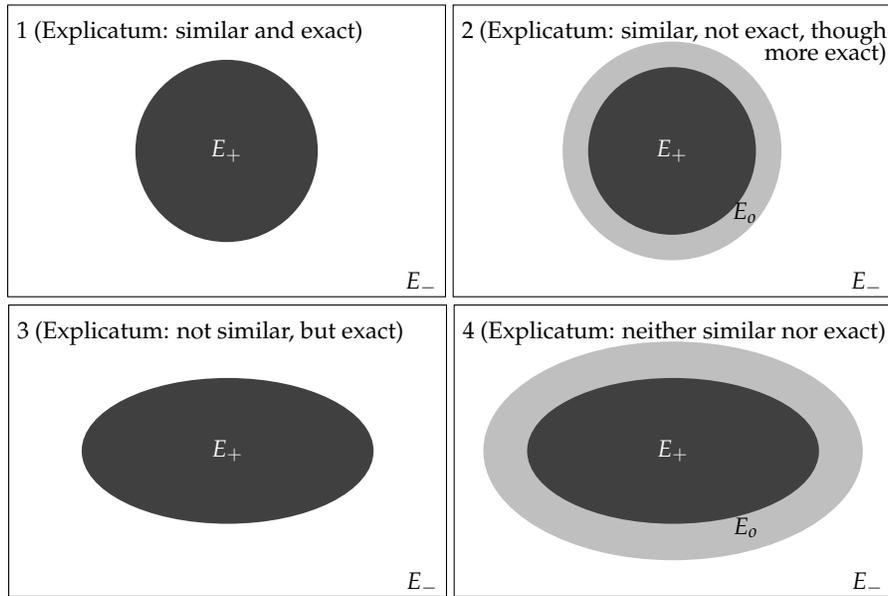


Figure 5: Possible cases regarding the interplay between similarity and exactness of an explication (the extensions of the respective explicandum are provided in figure 4)

Again, we can represent these cases by help of Venn diagrams as provided in figure 5. If we start with the extension of an explicandum as provided in figure 4, then schema 1 of figure 5 depicts the extensions of an explicatum of an adequate explication, since the vagueness extension is reduced (even eliminated) and the counter- and core extensions were at most expanded, but not reduced. In schema 2 also both conditions are satisfied, however, speaking in absolute terms the explication is inadequate since the explicatum is still vague (inexact in absolute terms)—nevertheless, there is progress since the vagueness extension of the explicatum is smaller than that of the explicandum. Schema 3 represents the inverse case: Vagueness is completely eliminated, however, the core- and the counter extension are not simply expanded by elements of the vagueness extensions, but rather some elements switched from being in the counter extension (of the explicandum) to becoming an element of the core extension (of the explicatum). Schema 4, finally, combines both problems of schemata 2 and 3.

[31] Now, we want to highlight again that the conditions provided here are

too strong in order to be generally ascribed to Carnap. So, e.g., in his *replies to his critics* in the Schilpp-volume on his philosophy he explicitly states that overlapping extensions is all one might ask for (cf. Carnap 1963). Even this “soft” constraint was contested by authors like Nelson Goodman (cf. Goodman 1951/1977, chpt.1). However, e.g., Hanna (1968) thinks that stricter extensional conditions (as, e.g., our conditions regarding similarity in C1) provide the most fruitful and simple rational reconstruction or explication of Carnap’s notion of *explication*. Also, when he speaks about explications before his more pragmatic approach in the Schilpp-volume, Carnap refers to pre-existing methodology which explicitly states such strong conditions. So, e.g., Menger (1943, §3, p.4) explicitly states:

**Ad similarity C1:** “A good definition of a word must include all entities which are always denoted and must exclude all entities which are never denoted by the word.”

**Ad exactness C2:** “A good definition should extend the use of the word by dealing with objects not known or not dealt with in ordinary language. With regard to such entities, a definition cannot help being arbitrary.”

**Ad fruitfulness and simplicity C3–C4:** “A good definition must yield many consequences, in particular theorems which are aesthetically satisfactory by their generality and simplicity, and theorems connecting the defined concept with concepts of other theories.”

Here we clearly find statements regarding extensional correctness as put forward by us above; we also find a hint to our interpretation of the stipulative (here: *arbitrary*) component of explications.

Regarding the conditions of fruitfulness (C3) and simplicity (C4) we want to restrict our attention to the fact that they provide other ways of making an explicatum more convenient in comparison to the explicandum it is based on. It is interesting to note that already Frege outlined a condition of fruitfulness when he claimed that “fruitfulness is the acid test of concepts” (cf. Frege 1979, p.33). We will say only a little bit more about an interpretation of these conditions when we spell out similarities between Aristotle’s and Carnap’s account of definitions in the next section. However, before we come to this point, for symmetry reasons we also want to briefly mention the main critique of Carnap’s account here.

[32] The main critique of Carnap’s account can be described by help of internal problems of the notion of an *explication* in the sense that there seem to be several tensions between the conditions of adequacy. Since the condition of simplicity (C4) is optional, we will not consider it here (Carnap explicitly states that in case of a tension with one of the other conditions, the simplicity constraint has to go). However, regarding the remaining three conditions three serious tensions were or can be criticised:

- **Tension C1 vs. C2 (similarity vs. exactness):**  
For the branch of ordinary language philosophy, Peter F. Strawson most

famously argued that an exact explicatum of an inexact explicandum will fail the similarity requirement, simply because the former is exact, whereas the latter is inexact, and hence both are dissimilar with respect to exactness (cf. Strawson 1963).

- **Tension C1 vs. C3 (similarity vs. fruitfulness):**

This is a worry which was shared by several authors:

- So, e.g., in 1942 Cooper H. Langford famously stated the so-called *paradox of analysis* according to which an analysis is correct only, if the result of the analysis is identical to the notion to be analysed; and that an analysis is informative only, if the result of the analysis is somehow different from the notion to be analysed. Hence, no analysis can be correct and informative at the same time.
- Also Strawson criticised a similar tension, when he claimed that an exact explicatum of an inexact explicandum may be fruitful with respect to some purposes, but typically not with respect to the purposes one had in mind when using the explicandum. This is the reason why, according to him, analysis needs to be performed about and within ordinary language (cf. Strawson 1963).
- Finally, recently Dutilh Novaes and Reck (2017) have put forward a problem of such a tension which they call the '*paradox of adequate formalisation*':

“On the one hand, a particular formalization [or explicatum] has to be sufficiently similar to its target phenomenon [or explicandum] to be rightly described as a formalization of that target phenomenon[. . . ] On the other hand, the formalization [or explicatum] will be more useful [. . . if it] reveals something new[.]” (cf. Dutilh Novaes and Reck 2017, p.211)

Note that the paradox of formalisation is structurally similar to the above-mentioned paradox of analysis, however, it is narrower in the sense that every formalisation is an analysis but not the other way round, and it is broader in the sense that the paradox of analysis is about a tension between similarity and informativity in particular (which is about one particular end and a particular type of fruitfulness towards this end), whereas the paradox of formalisation is about fruitfulness in general.

- **Tension C2 vs. C3 (exactness vs. fruitfulness):**

Although we do not know of an explicit critique of this kind in the literature, it seems to be plausible to assume that also between the exactness and the fruitfulness condition a tension might show up. In principle it might be possible that in some contexts less exact (and more vague) predicates might allow for more fruitful applications and derivations as

exact (not vague) ones. One might think, e.g., on discussions about legal systems where often the question about the value of vagueness arises (cf., e.g., Asgeirsson 2015). In such a context vagueness might be a feature increasing fruitfulness, [33] and hence this might be a context where exactness runs counter fruitfulness. Just to give an example, it is sometimes argued that vagueness of the notion of *negligence* allows for a fruitful coverage of a broad and diverse range of cases with the norm “Parents should not be neglectful toward their child.” as, e.g., cases where parents do not spend enough time with their children or do not care for adequate nutrition, etc. (cf. Asgeirsson 2015, sect.III).

Since we now have presented our reconstruction of Aristotle’s and Carnap’s account of definitions/explications in detail, we can go on with a simple comparison and highlight similarities as well as important dissimilarities between both accounts.

## 5 Comparing the Conditions of Adequacy of Aristotle’s and Carnap’s Account

Now, after the reconstruction of Aristotle’s theory of definitions, its main critique, and Carnap’s theory of explication we can take stock and compare both accounts with each other. Starting with Aristotle, we discussed five conditions of adequacy for definitions: **A1** and **A3** which are about a definition neither being too narrow nor too wide; **A2** which is about locating the *genus* correctly; **A4** which is about the *genus* and *differentiam* providing an essential characteristics; and **A5** which is about clarity and relevance of the defining characterisation.

Regarding Carnap’s account we discussed four conditions of adequacy for explications: **C1** which is about the similarity between explicatum (resulting notion of an explication) and explicandum (the notion to be explicated); **C2** being about the exactness or relative exactness of the explicatum; **C3** which is about the fruitfulness of the explicatum; and **C4** being about the simplicity of the explicatum.

Now, what is left is to link both approaches as promised at the beginning. The way we framed these accounts, it seems, makes this to some degree a simple task of identification. We think that a reasonable way to relate both accounts seems to be as follows:

Both accounts have conditions of adequacy which compare extensions: Carnap’s condition of similarity between explicatum and explicandum (**C1**) demands, according to our extensional reading, that the (clear-cut) cases of the core and counter extension of a given notion—the explicandum—are transferred to the newly devised notion—the explicatum. On the other hand, Aristotle’s condition of a definition being neither too narrow nor too wide (**A1** and **A3**) is about an exact matching of defined *X* (definiendum) with—the, for the definition used,—*GD* (definiens). There is, what we want to

call, a “Platonic reading” of this condition in the sense that one might suppose that defining consists in a mapping of pre-existing notions as follows:  $X, G_1, \dots, G_n, D_1, \dots, D_m$  are notions of our conceptual repertoire, i.e. notions we are somehow empirically or pre-theoretically familiar with (sloppily: notions of a *Platonic heaven*), and the task of defining with respect to conditions A1 and A3 consists in mapping  $X$  to a combination of  $G_i D_j$  ( $1 \leq i \leq n, 1 \leq j \leq m$ ) such that they are co-extensional (other conditions of adequacy take care that defining is about the right *genus, essence*, etc.). In this interpretation it remains unclear how exactly “mapping in the Platonic heaven” works. For this reason we want to propose a more pragmatic interpretation in the sense of purpose-dependent mapping: According to this interpretation, what we [34] have is a *notion in use*  $X^A$  and in defining we look out for a  $X^\Omega = GD$  such that  $X^A$  and  $X^\Omega = GD$  are in some sense co-extensional. We think that the description of conditions A1 and A3 we provided above (section 2) are in favour of such a reading, particularly when Aristotle states that defining is “to apply the account [ $X^\Omega = GD$ ] to that to which the name is applied [ $X^A$ ]” (Aristotle 1995, *Topica*, book VI, 139a, p.524). Also, in this interpretation it is still underdetermined in which sense one can “test” for extensional accuracy. However, it seems to be quite natural and in an empiricist spirit to operationalise whether “a definition of man” *really* “is true of every man” by help of an explicational mapping: the latter notion (*man* in “every man”) is the explicandum  $X^A$ , and the former (*man* in “definition of man”) the explicatum  $X^\Omega$ . In this sense we think that the condition of adequacy C1 can be mapped to the conditions of adequacy A1 and A3 (or better: in this sense we propose to explicate Aristotle’s conditions further).

Next, let us come to the condition of exactness of the explicatum (C2). We think that this condition relates to the condition of clarity (A5) of Aristotle as follows: The idea is that often the vagueness extension of some expression ( $E_o$  as depicted in schema 5 of figure 1) can be, at least partly, reduced via definition by help of unambiguous, non-metaphorical, etc. expressions. Up to now we did not say much about the clarity and relevance condition A5. Here Aristotle is a bit more concise when he specifies conditions for clarity and relevance better:

Ad **Clarity** (cf. *Topica*, book VI, chapter 2, 140a—(Aristotle 1995)):

- A5.1 **Unambiguous**: “One commonplace rule, then, in regard to obscurity is to see if what is stated is homonymous with something [...; in such a case] it is accordingly not clear which of the several possible senses of the term he intends to convey. Likewise also, if the term defined is used in different ways and he has spoken without distinguishing between them;” (cf. *Topica* VI.2, 139b18-26, trans. Pickard-Cambridge)
- A5.2 **Not metaphorical**: “Another rule is to see if he has used a metaphorical expression[.]” (*Topica* VI.2, 139b32, trans. Pickard-Cambridge)

**A5.3 Commonly used expressions:** “Again, see if he uses terms that are not in current use [...]. For an unusual phrase is always obscure.” (*Topica* VI.2, 140a3-5, trans. Pickard-Cambridge)

**A5.4 Clear demarcation of counterexamples:** “Moreover, see if from the expression used the account of the contrary is not clear; for definitions that have been correctly rendered also indicate their contraries as well.” (*Topica* VI.2, 140a18-20, trans. Pickard-Cambridge)

**Ad Relevance** (cf. *Topica*, book VI, chapter 3, 140a&b—(Aristotle 1995)):

**A5.5 Correct locus in the sense that G is within the genus and D within the species:** “For the genus ought to divide the object from other things, and the differentia from any of the things contained in the same genus. Now any term that belongs to everything separates off the given object from absolutely nothing, while any that belongs to all the things that fall under the same genus does not separate it off from the things contained in the same genus. Any addition, then, of that kind will be pointless.” (*Topica* VI.3, 140a27-32, trans. Pickard-Cambridge) [35]

**A5.6 Logically weakest definiens:** “Everything is superfluous upon whose removal the remainder still makes the term that is being defined clear.” (*Topica* VI.3, 140a37-b2)

Although this further specification contains also some idiosyncrasies of Aristotle’s metaphysics (e.g. A5.5 which is better mapped to the fruitfulness condition C3 which we will briefly discuss below), most of it can be regarded to be in favour of a mapping of the exactness condition C2 to A5: Providing an unambiguous, non-metaphorical, and well-understood explicatum (A5.1–A5.3) is implicitly linked by Carnap to C2: “The philosopher starts with this vague, ambiguous, incomplete explicandum, and must find a precise, unambiguous, complete, simple, and fruitful explicatum” (Carnap 1963, p.713). Carnap also links *exactness* to *unambiguouity* and *clear demarcation/non-vagueness* when he replies to Yehoshua Bar-Hillel’s discussion of linguistics and metatheory:

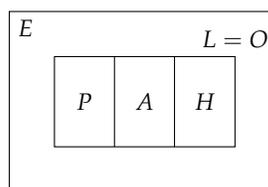
“I share, of course, [Bar-Hillel’s] view that linguists have the task of describing the actual use of language [...] and not an improved use that might be proposed by a logician. [...] Still, the] metalanguage to be employed in linguistics should, for instance, not use a word as *vague and ambiguous* as ‘salt’, but instead expressions with clearer meanings, e.g., ‘kitchen salt’ and *exact terms* of chemistry. With the help of these *exact terms* the linguist could describe the specific kind of *vagueness and ambiguity* of the word ‘salt’ of the ordinary language in various contexts[.]” (cf. Carnap 1963, p.942,

fn26a, my emphasis, although he does not speak directly of explications there, he speaks also of other conditions of explications, like fruitfulness, for which reason his *exactness*-parlance naturally links to explications.)

Also the sub-condition on a clear demarcation of counterexamples (A5.5) we take to be in favour of our linking of clarity A5 and exactness C2 in the sense that such a clear demarcation avoids unclear cases which we generally assigned to the category of *vagueness*. So, this is how we think that C2 relates to A5. Although we think that our mapping is roughly right, clearly it also has many restrictions and shortcomings—we will discuss some of them briefly below.

Now, regarding Carnap’s fruitfulness condition (C3): By stretching the band of interpretation a lot, we think that this condition can be linked to Aristotle’s condition of finding the correct *locus* (A2). The idea is that once one buys Aristotle’s assumptions of a hierarchical ordered ontology with all its implications regarding necessity relations and nomicity, then the way to go for forming notions ought to be in accordance with the hierarchical structure in order to account for these. Clearly, this is a topic too far-reaching in order to be adequately dealt with here. Nevertheless, at least we can briefly indicate how spelling out the details of such a link might work by help of an example: Thinking about living beings, it is well-known that Aristotle distinguished three different types of soul, a vegetative ( $V$ , also: *nutritive*), a sensitive ( $S$ ), and a rational ( $R$ ) soul (cf. his *De Anima*, book III, 12 and *Generation of Animals*, book II, 3 among others). Now, let us suppose a simplified ontology with entities  $E$ , living beings  $L$ , plants  $P$ , non-human animals  $A$  and humans  $H$  (for simplicity of expression we deviate here from Aristotle’s subordination of *men* under *animal*). In accordance with a simple hierarchy as depicted below, we define by help of the notion of animated (having a soul) beings  $O$  (where we suppose, for simpler depiction, that  $V$  stands for having a vegetative soul only,  $S$  stands for having a vegetative and sensitive soul only, and  $R$  for having also a rational soul): [36]

- $O = V \cup S \cup R$
- $L = E \cap O$
- $P = O \cap V$
- $A = O \cap S$
- $H = O \cap R$



Now, we could have characterised  $P/A/H$  not only by help of the *genus proximum* ( $L$ ) and the *differentiam specificam* ( $V/S/R$ ), but also by help of the more remote *genus*  $E$ :  $P = E \cap V$ ,  $A = E \cap S$ ,  $H = E \cap R$ . Such characterisations would be extensionally equivalent. However, in this case a relevant unifying feature of all entities belonging to  $P, A, H$ , namely the feature of *being animated* ( $O$ ), would go unnoticed and hence, correlations among dispositions and properties of these entities “propagated” via this relevant common feature would remain unexplained until it would have been established separately. Clearly,

such common features are not always epistemically accessible from the beginning on. However, the *genus proximum*-condition (A2) is always relative to a given ontological hierarchy, and so one is asked that, once one revises one's ontology, one also needs to reconsider one's definitional relations. We find famous examples of this kind in all disciplines of science as, e.g., the revision of our notions of *magnetism* and *electricity* due to ontological revisions introducing electromagnetic fields, etc. This is, of course, only a very rough sketch of how we think that Aristotle's A2 relates to fruitfulness considerations of Carnap (C3) via unification (for details of ontological revision via hierarchical common cause abduction and its unificatory impact see, e.g. Schurz 2008; and Feldbacher-Escamilla and Gebharder 2019).

Another way to spell out fruitfulness of Aristotle's conditions of definitions is provided, e.g., by Weingartner (1991, pp.212–214): In this excellent investigation it is shown how from a derived rule of Aristotle's theory, according to which a definition cannot occur as a conclusion of a demonstration, it follows that definitions ask for finding middle terms (interpolations) as *definientia* and by this allow for explanations. It seems that this goes into a similar direction as the above-mentioned common cause abduction where the ontological hierarchy is enriched by common causes in order to account for otherwise unexplained correlations.

Finally, and only very briefly (since it is also only a more or less optional condition of adequacy for Carnap), considering simplicity (C4) we want to mention that an element of this condition can be found also in Aristotle's relevance condition (A5): So, e.g., particularly opting for the logical weakest characterisation (A5.6) is one prototypical case of providing a simple explicatum (C4).

To sum up, what we suggest here is that there are relevant similarities between the traditional account of definition and that of explication. They can be mapped as in table 1.

Carnap		Aristotle
Similarity	C1 A1,A3	Neither too narrow nor too wide
Exactness	C2 A5	Clarity (particularly A5.1–A5.4, see below)
Fruitfulness	C3 A2	Correct <i>locus</i>
Simplicity	C4 A5	Relevance (particularly A5.5–A5.6, see below)

Table 1: Mapping of adequacy conditions for definitions and explications

Clearly, some provisos are in place: First of all, both provided reconstructions are to some degree only about simplified versions. Regarding explications we mentioned already that [37] we focus on the explication of a single notion (rather than a system of notions or a theory, etc.) and that we are presupposing an extensional reading in the line of (Hanna 1968). However, recently both assumptions were criticised particularly due to their linear, separated, and non-dynamical structure (cf., particularly, Brun 2017). Although we agree that the broader method of explication needs to take into account also dynamical features, we think that in some relevant cases a linear and static structure suffices for applying this method. Particularly, we think that when one aims at explicating the conditions of Aristotle’s account of definition, at least in a first step, the extensional account of explication suffices this purpose. With respect to exactness, we want to add that we focused on cases of vagueness or, more generally, on cases which are underdetermined by principles put forward in order to characterise a notion. However, these are only very particular cases of inexactness and it might easily turn out that a more general framing of this condition deviates much more from the counterpart we identified in Aristotle, namely clarity and relevance (A5). However, again, we consider our discussion here only as a first step towards linking the two accounts and think/hope that further investigation of Aristotle’s account allows for putting forward further relations. Finally, regarding Aristotle’s *locus*-condition (A2) there is clearly much more to be said about it, however, due to its entrenchment with his philosophy of science and metaphysics this would also go way beyond the scope of this paper. The same holds for the counterpart *fruitfulness*-condition (C3), which is a very heuristical, broad, and in some sense also *delicate* matter.

As we have seen, some of the conditions of adequacy put forward by Aristotle find a more or less direct match in Carnap’s conditions (and vice versa), and some of them are loosely linked to each other. However, it becomes clear from the mapping in table 1 that there is particularly one element of Aristotle’s theory which is not even loosely linked to Carnap’s account of explications, namely the essentialism requirement A4. When discussing the main critique of Aristotle’s theory in one of the preceding sections, we mentioned already that essentialism was heavily attacked because, so the main allegation goes, conditions and criteria for distinguishing accidental from essential properties and relations are unclear. Not only Popper, but also Carnap argued against essentialistic claims: “[I suggest that] traditional ontological problems, in contradistinction to the logical or syntactical ones, for example, problems concerning “the essence of number”, are entirely abolished” (cf. Carnap 1963, p.55).

Although Saul Kripke’s (1980/1981) approach to *necessity* is sometimes considered to rehabilitate Aristotelian essentialism, and although also one might see some links between the essentialistic requirement and Carnap’s discussion of analyticity, it seems to us that particularly A4 provides a case of a strong dissimilarity between both accounts. It is also this condition which marks a main difference between *real definitions* and *nominal definitions* (see section 3). However, as we have tried to argue for in this section, if one gives up this condition, then it becomes clear that the (other) conditions of adequacy put forward for

*real definitions* have matching counterparts which were put forward for a particular type of nominal definitions, namely *explications*.

After these provisos and our further specification, we also want to highlight some advantages of our comparison: First of all, Carnap himself links his approach to the tradition of Kant (cf. Carnap 1950/1962, §2, p.3), but, as it seems to us, there are also strong similarities to Aristotle for which reason we think that one can also place this account of analysis and definition into a much longer tradition, and by this one can argue [38] for some form of methodological continuity in the camp of analytic philosophy and its predecessors. Second, Aristotle's assumption about a hierarchical ontological structure, which importantly enters also his thoughts about the structure of scientific notions and theories, clearly is outdated nowadays, similarly as is his logic from a modern standpoint. However, his syllogistic still serves as a nice and didactical valuable system for illustrating the syntax (syllogistic figures and modi) and semantics (Venn diagrams) of logics as well as important meta-logical insights (square of opposition). Similarly, one might think of Aristotle's thoughts about the metaphysics and philosophy of science as a valuable illustration of fruitfulness considerations: Once we know about or assume a hierarchical structure of properties, *GD*-definitions allow for a maximum degree of systematisation (see above). Finally, and more importantly, we can also draw some conclusions in the other direction, namely employing Carnap's systematic account for clarifying that of Aristotle: So, e.g., the traditional condition of a definition neither being too narrow, nor too wide (A4) makes sense only, if we make clear *in which respect* it might be too narrow or too wide. Carnap's distinction between a notion we start our analysis with, the explicandum, and a notion which is the result of our analysis, the explicatum, allows for spelling out in detail *in which respect* a definition can be too narrow or too wide, namely in the sense of being not similar due to counter- or core extensional incorrectness (see section 4). Also, Aristotle's condition of clarity and relevance can be understood better in the light of Carnap's exactness constraint: If we distinguish the language of the explicandum (typically ordinary or any other pre-scientific language) from that of the explicatum (typically a scientific or logical language), then we get a better grasp on what it means for a definition to be clear, namely that it is formulated by help of clear rules of an exact or at least more exact language. In this context it is interesting to note that one main result of the modern theory of definitions is that for exact languages two general formal conditions for adequate definitions can be identified, namely the so-called condition of non-creativity according to which no new theorems formulated in the language without the defined expression should be derivable by help of a definition. And the condition of eliminability according to which every formula of the language with the newly defined expression needs to be (definitionally) equivalent with a formula of the language without the new expression (for details of these two criteria cf., e.g., Suppes 1957, chpt.8). As a bottom line one might see in the shift of focus from real to nominal definitions due to the *essentialism critique* of the modern era and early analytic philosophy a key factor, which allowed for systematising the theory of definitions further and culminated in the ab-

stract and comprehensive formal treatment of definitions of the contemporary account. Although this shift of focus seemed to be important for progress, still, as we tried to argue here, Aristotle's account contains already many important elements of the contemporary account.

## 6 Conclusion

Aristotle's theory of definition has influenced philosophical inquiry for more than one and a half millenia. Disregarding further principles of entrenchment with his philosophy of science and metaphysics, it consists of five conditions of adequacy, namely two on extensional correctness, a condition on correct location, one essentialism requirement, and a condition on clarity and relevance. [39]

In the course of the critique of essentialism, Aristotle's account was replaced by other, more pragmatic forms of definition, amongst others by Carnap's approach of explication. The theory of explication consists of four conditions of adequacy, namely a condition on similarity, one on exactness, one on fruitfulness, and one on simplicity. In this paper we have argued that, with the exception of the essentialism requirement, both approaches share relevant similarities and can be mapped to each other in such a way that some problems of interpretational underdetermination can be plausibly resolved by reference to the respective counterpart conditions: E.g., Aristotle's conditions of extensional correctness can be interpreted against the backdrop of Carnap's condition of similarity once one skips the essentialism requirement and refers to an established use of language instead. By this, the question *with respect to what* a defined notion is supposed to be extensionally correct or not is no longer left open, but determined: *with respect to an established use of language*. And the other way round, Aristotle's account can be used, e.g., to illustrate some of the Carnapian conditions of adequacy. So, e.g., Aristotle's account with a background-assumption about a hierarchical ontology can be used to outline fruitfulness considerations as indicated by Carnap in terms of unificatory power.

In this sense, a standard interpretation of Aristotle's theory of definition and Carnap's account of explication seem to fare well if it is performed in a complementary way.

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