Semantic Information and Information Security:

Definitional Issues

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Abstract


This licentiate thesis consist of two separate research papers which concern two tangential topics – that of semantic information and that of information security. Both topics are approached by similar methods, i.e. with a concern about conceptual and definitional issues. In Paper I – concerning the concept of information, and a semantic conception thereof – the conceptual, and definitional, issues focus on one property, that of truthfulness. It is argued – against the veridicality thesis – that semantic information need not be truthful. In Paper II – concerning information security – it is argued that the current leading definitions (so-called ‘CIA’ definitions, which define information as secure if, and only if, the properties of confidentiality, integrity, and availability are retained) suffer from both actual and possible counter-examples, and lack an appropriate conceptual sense. On the basis of this criticism a new kind of definitions is proposed and argued for.

*Keywords*: definitions; distinctions; philosophy of information; philosophy of risk, security; information; information security; semantics; semantic information; veridicality thesis; informativity; RIGHT; CIA.
Thesis Composition

This licentiate thesis consists of an introduction and the following research papers:

I. Björn Lundgren “Does Semantic Information Need to be Truthful?” (under review).

II. Björn Lundgren & Niklas Möller “Defining Information Security” (revise and resubmit).

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Svensk sammanfattning

I denna avhandling återfinns två artiklar och en introduktion. Denna svenska sammanfattning fokuserar kortfattat på artiklarnas innehåll.

Artikel 1 rör frågan om vad information är, specifikt givet en semantisk förståelse av information eller sådan information som begreppsligt är av en semantisk natur.

Artikeln kritiserar the veridicality thesis (ungefär: sanningstesen) som förfäktas av bland andra Luciano Floridi. Tesen innebär att (semantisk) information måste vara sann/sanningsenlig (true/truthful).

Artikeln presenterar både motargument direkt mot sanningstesen, så väl som motargument mot pro-argument för sanningstesen. Det slutgiltiga bidraget är en distinktion mellan egenskapen att vara informativ och egenskapen att vara information. Denna distinktion löser en av de svårare knutarna för de som – likt denna tes’ författare – förespråkar tesen att (semantisk) information är aletiskt neutral. Dessa typer av teorier har nämligen tidigare ansetts lida av den motsägelsefulla konsekvensen att kontradiktioner är maximalt informativa.

Artikel 2 kritiserar den ledande definitionstypen av informationssäkerhet och presenterar ett nytt definitionsförslag. Den är medförfattad av Niklas Möller.

Informationssäkerhetsbegreppet är mångtydigt, det kan åsyfta exempelvis informationssäkerhet som en praxis eller ett akademiskt ämne. Vi har fokuserat på att definiera när någon information eller något informationssystem är säkert (skyddat).

Den klassiska definitionstyp vi kritiserar så är så kallade CIA-definitioner. CIA står för de tre egenskaperna: confidentiality (konfidentialitet), integrity (riktighet) och availability (tillgänglighet). De svenska översättningarna kan diskuteras, men återfinns exempelvis i den statliga utredningen "Informations- och cybersäkerhet i Sverige" (SOU 2015:23). Denna SOU är dock i allmänhet inget att luta sig på när de gäller de enskilda definitionerna; bland annat eftersom den lyckats
blanda ontologiska och epistemiska definitioner av begreppen (jfr Lundgren 2015a).

I artikeln lägger vi fram några motexempel till varför dessa kriterier varken kan vara nödvändiga, tillräckliga eller ge oss begreppets mening på ett adekvat sätt. Vi föreslår sedan följande definitioner:

Säker information:

- Varje information (I) är säker om, och endast om, för varje agent A gäller att A har rätt access-relation till varje del av I.

Säkert informationssystem:

- Varje informationssystem (S) är säkert om, och endast om, för varje agent A gäller att A har rätt access-relation till varje del av S.
**Introduction**

1. **Introducing the introduction**

The purpose of this licentiate thesis is to present philosophical accounts of (semantic) information and (information) security. The purpose of this introduction is to supply a relevant contextual basis for these topics as they are presented in my papers.

In this licentiate thesis you will find two research papers with varied intended readership, dealing with different subject matters. Despite their difference, the essays are interconnected not only through their theme, but also through their methodology.

The methodological connection between the papers is quite clear; both papers discuss, or contribute to, definitions of its inter-related topics. Paper I discusses whether the criterion of truth(fulness) is necessary for semantic information, while Paper II supplies a definition of when information (systems) are secure.

Since the question of security is dealt with under the application of information security, the two papers are therefore thematically connected via the concept of information. While it is argued, in Paper II, that the question of how to define information security is orthogonal to the question of what information is, there are still themes connecting them. That we can define when information is secure without precisely delimiting the exact nature of information does not mean that the question of the essential nature of information is insignificant once we start to ask other (philosophical) questions or once we apply the definition (as is recognized in Paper II).

Before getting into the actual issues I will briefly sketch my methodological basis for this thesis (section 2). With that in mind I will then turn to the two topics; section 3 will deal with information, specifically semantic information, and section 4 will deal with security, specifically information security. Each section will include a brief
summation of some of the main points of the papers, as well as a minor contextualization of the topics. After this, the papers will follow.
2. The role of definitions and distinctions in philosophy

In this section I will discuss definitions and its methodology, for if there is one thing that clearly brings this thesis together it is the methodological use, or discussion, of definitions. In both of the papers of this essay I either try to give a satisfactory response to the question *what is the definition of x?* or I argue that *c is not a necessary criterion for x.* The purpose of this section is to supply a brief background and introduction to the topic, as well as a partial sketch of my current thinking on these issues. This discussion will be limited by the spatial constrains, meaning that various arguments will have to be simplified and/or omitted.

Despite the prominent role of definitions and distinctions in philosophy surprisingly little has been written on definitions (and less on distinctions). The only main textbook on definitions, Robinson (1950), has, despite its virtues, serious downfalls. Few attempts at writing a new textbook have been made, Roy Harris’ and Christopher Hutton’s *Definition in Theory and Practice: Language, Lexicography and the Law* (2007) is one example.

The subject is curiously underdeveloped. Raziel Abelson claimed in *The Encyclopedia of Philosophy* that “no subject is more in need of a fresh approach” (Abelson 1967: 314). According to Harris and Hutton this was still valid at the time of their writing (2007: ix). In 1993 Nuel Belnap wrote a disclaimer in his “On Rigorous Definitions” that “There is, alas, hardly any literature on this topic. The discussion will therefore be preliminary, all too elementary, and imperfectly plain.” (1993: 115). Although things have happened in the last 50, 20, or 10 years, there is still more to do. But if little of substance has been written on the theory of definitions, then hardly anything of substance have been said about distinctions. Definitions and distinctions are truly worthy of more study.

But why, one may ask, should we care about definitions and distinctions and why are these issues important for my papers?

To ask why we should care about definitions and distinctions is to ask why we should care about philosophy at all (or at least analytical
philosophy). Firstly, any (philosophical) analysis requires distinctions. In order to say anything about anything, we need to be able to distinguish something from another. Secondly, the result of a lot of philosophy is, in some form or another, (a) definition(s).¹

We may specify the previous discussion by asking what the specific values of definitions are and when are they valuable (supposing that everything it not worthy definition of analysis).

Let us being with the former question. What a definition does, irrespective of its kind, is – if it is successful – to supply a special form of clarification of a concept. If you have a theory about, e.g., information, then a definition of information offers, relative to your theory, a clarification of the scope of your conception of information. Given your definition the question of what actually belongs to the extension of the concept – supposing its formal rigor – ought to be clear. It, thus, becomes easier to reason about potential counter-examples to your theory, and as such it becomes clear when arguments are needed.

The value of definitions does not end with that; since just as the extension of a concept can be used to evaluate a definition, a convincing definition can be used to evaluate a concept’s extension. It should be noted that this not an empty circle of analysis, for the relation is – or should be – that of mutually explication until it reaches equilibrium: definition ⇔ extension. Of course, as before, arguments are needed to support each modification of definition / extension. The question of the balance between the supposed extension of the terms and the extension according to the definition is not easily settled; and it is a question that will have to be settled another time. Either way, a definition helps us to clarify (1) that there is a conflict, and (2) the precise nature of that conflict.

¹ It should be noted that I am not conceptually mistaking analysis for definition (like Robinson 1950 claimed many have done when it comes to so-called ‘real definitions’, see the upcoming subsections). What I am saying is that when we embark on a goal of analyzing a certain concept we often express the result of such an analysis by a definition of the analyzed concept.
So definitions may be motivated by a need, or desire, to clarify what it is that we talk of when we talk of x. This brings us to the related question: what is valuable to define? Just because definitions in general can help to clarify conceptual issues it is not clear that all conceptual issues are worthy of discussion – and therefore it is not clear that all clarifications are worthy of consideration. Take, for example, information; which sub-classes of information are worthy of definitions? Now, there are many sub-classes that we *could* define, e.g., we could make a definition of a sub-class such that all information written in English using 47 letters will hence be known as E47-information. However, a general principle for giving attention to definition of a specific sub-class should be that it would be of some (philosophical) interest to do so; i.e. either the sub-class, or the demarcation of that sub-class, needs to be of some (philosophical) interest. Clearly, E47-information would neither supply us with an interesting sub-class, nor an interesting demarcation.

Given the above answer to these general questions it should be clear that definitions – and a discussion thereof – are of value also, specifically, to the papers in this thesis; since I aim to discuss specific concepts concerning information and security – definitions and distinctions play an important role.

What I will do in this section – which I have already started doing – is to present a brief introduction to the topic of definitions (and to some extent distinctions) and part of my methodological take on these issues. However, it should be noted that even though this contributes to my papers, the papers do not *depend* on my philosophical ideas in this section. Thus, as the papers are stand-alone works they can be read and interpreted on the basis of other meta-considerations on definitions or on the basis of no other considerations at all.

The rest of this section will be structured as follows: In subsection 2.1 I will deal with some basic formalism of definitions. In the following subsection (2.2) I will give an account of different kinds of definitions. After that I will follow up with three comments, firstly on a mistake on
the relation of distinctions and definitions as exemplified in the origins of the discussions on definitions (and distinctions), in 2.3. Secondly, on the question of whether definitions can be true and/or false, in 2.4. Thirdly, and finally, in 2.5, on the question of whether there are such a thing as real definitions, and what a characterization of real definitions would require.

2.1 Formalism and basic criteria

The standard formula for a definition is a complex which consists of three things: a definiendum (that which is to be defined), a definiens (that which defines), and a defining connective. The standard formula may be characterized as below:

\[ \text{DEFINIENDUM } \Omega \text{ DEFINIENS} \]

in which \( \Omega \) is a placeholder for a definitional connective, commonly an equivalence relation (I will return to the definitional connective after discussing a few other points).

However, Gupta makes a point that:

Many definitions—stipulative, descriptive, and explicative—can be analyzed into three elements: the term that is defined (\( X \)), an expression containing the defined term (\( \ldots X \ldots \)), and another expression (\( \ldots \ldots \ldots \ldots \)) that is equated by the definition with this expression. Such definitions can be represented thus:

\[ (2) \quad X: \ldots X\ldots =df \ldots \ldots \ldots \ldots \ldots . \]

I'm basically in agreement with Gupta; but the important thing is that \( X \), as part of the definiendum, must be contextualized properly. Meaning that one must clarify what kind of thing one is defining. It is not always prima facie clear what kind of thing that one is defining. For example, in Paper II it is argued that a definition of information security can be very many things, information security praxis, information security as an academic field, information security as something you do. We argue that what is most interesting and pressing to define is the state when
information is secure. This is what I mean by contextualizing the definiendum. We must clarify what kind of entity we are defining. Thus, while definiens supplies “the definition” (in a common sense way of expressing it), the definiendum directs scope and context of the term to be defined (cf. Belnap 1993).

So much for the basic form. Nuel Belnap argues that there are two standard criteria for definitions:

- **Eliminability**: when we replace a word or concept by a definition the definition should cover *all the meaning* of the word/concept that we replaced. (ibid: 119)

- **Conservativeness**: when we replace a word or concept by a definition it should not add any new meanings beyond the word/concept that we replaced (i.e. it should cover only the meaning of the word/concept). (ibid)

Given the above characterization of eliminability and conservativeness any definitions that satisfy both criteria is a definition with definiens that supply jointly necessary and sufficient criteria (sufficient because it captures all of the meaning, and necessary because it adds nothing to the meaning). However, as Belnap notes these criteria are context-sensitive. No definition allows elimination in every context (ibid: 121), which is part of the reason why contextualization is so important.

Now, there is one thing about conservativeness that needs be noted in order to avoid confusion. It is not uncommon that we introduce definition of concepts, or entities, partly because of previous misconstructions and/or misunderstandings. The definition, as such, is supposed to bring clarity to a situation where there was confusion. However, given that such definitions actually add something to what is previously known or thought, it may seem as if the criteria of conservatism cannot be satisfied. This is, of course, the reason why a new definition – as previously mentioned – ought (i.e. need) to be supplied by arguments that makes it sensible, and conservativeness can then be retained relative to those arguments. In such cases what one
does – and what I hope I have done in my papers – is to show that there is confusion that can be resolved by adapting a definition that is true to the clarity of how we should understand some particular concept.

The connective ($\Omega$) can vary with different applications. Standardly we seek a definition that supplies necessary and sufficient conditions, requiring an equivalence relation, but for certain purposes it may be appropriate to define only necessary or sufficient conditions. However, for most common applications, neither sufficient nor necessary conditions alone are considered sufficient for a proper definition (i.e. the necessary and sufficient conditions for a proper definition are necessary and sufficient conditions). This inadvertently brings us to the next issue; i.e. that of circularity.

It is a fairly widespread and common idea that definitions need to avoid circularity. However, such a conception can take us too far, partly because circularity does not necessarily imply that the circles are either vicious, or empty.

According to Gupta and Belnap circularity is not necessarily a sign of a formal error. Based on a comparison between the behavior of the concept of truth (in certain special cases, such as certain truth-paradoxes) Gupta suggests:

Concepts with circular definitions, then, behave in ways that are remarkably similar to the behaviour of the concept of truth. They exhibit the same kinds of pathological behaviour as truth [such as the liar or the truth-teller paradoxes]. And like truth, they can be, and usually are, unproblematic over a range of cases. These similarities suggest, first, that the outright rejection of circular definitions in logic may be too precipitous. For their behaviour is very much like that of a concept that we do accept, and want to accept. Perhaps a more general logic of definitions is possible that will show us how to make sense of, and work with, circular definitions. Second, the similarities suggest that the perplexing behaviour of the concept of truth might be explainable as arising from some circularity in its definition. Nuel Belnap and I have come to believe, after much hesitation, that these
suggestions are more than mere possibilities, that they are close to actuality. (Gupta 1989: 233, addition within brackets by me) Gupta then goes on to show how we can make sense of circular definitions. He shows this formally by introducing introduction and elimination rules that works for circular definitions. For spatial reasons I will not expand on the formalism of this account here, but it suffices to say that the basic idea is that “[t]he meaning a circular definition ascribes to its definiendum [---] should be viewed as having a hypothetical character” (ibid: 234). The idea is that we can determine the extension of the definiendum on the basis that we know the extension of the circular notion, i.e. if G is in both the definiens and the definiendum then we can determine the extension of the definiendum if we are given the extension of G (ibid: 235).2

Burgess (2008) develops an account based on Humberstone (1997). Burgess aims to clarify the difference between benign and malicious circularity in definitions. He distinguishes himself from Humberstone by introducing a more liberal account of inferential circularity. According to Burgess Humberstone calls a definition inferentially circular “if either the verification or the falsification procedure contains a loop, even if the route to that loop is not compulsory”, while Burgess require that the loop cannot be avoided. For example, \( p = \neg \neg (p \land q) \lor r \) is inferentially circular according to Humberstone, since verification by ‘p and q’ introduces a loop. However, it is not inferentially circular according to Burgess, since it can be verified by ‘r’ (Burgess 2008: 220f).

Burgess suggests that “a definition is informative if it sometimes gives us helpful information; it should not be required to do so on all occasions” (ibid: 221).

Clearly, what kind of circularity is problematic depends on the kind of definition and its purpose, which brings us to the next topic.

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2 The full account of their theory is developed in Gupta and Belnap 1993.
2.2 Distinguishing between different kinds of definitions

A standard distinction among definitions is between nominal and real definitions.

A nominal definition is concerned with meaning(s) of words, while a real definition is concerned with objects or concepts. The specific terminology seems to originate from Locke’s distinction between real and nominal essence (cf. Gupta 2015), although similar conceptual ideas were prominent already with Plato.

Robinson (1950) distinguished between word-word, word-thing, and thing-thing definitions, in which the two former are nominal and the latter is real. Needless to say, we often use words to qualify which thing that is defined as that thing. That we use words does not imply that the definition is nominal, the question hangs on if it is about the words or not.

Gupta suggests the following:

Perhaps it is helpful to indicate the distinction between real and nominal definitions thus: to discover the real definition of a term X one needs to investigate the thing or things denoted by X; to discover the nominal definition, one needs to investigate the meaning and use of X. Whether the search for an answer to the Socratic question “What is virtue?” is a search for real definition or one for nominal definition depends upon one’s conception of this particular philosophical activity. When we pursue the Socratic question, are we trying to gain a clearer view of our uses of the word ‘virtue’, or are we trying to give an account of an ideal that is to some extent independent of these uses? Under the former conception, we are aiming at a nominal definition; under the latter, at a real definition. (Gupta 2015)

While everyone agrees that there are nominal definitions, there have been some controversies surrounding real definitions. I will get back to these controversies in subsection 2.5. In that subsection I will also qualify the concept of real definitions a bit further.
Another distinction is between the extension and the intension of a concept, C. The extension of C is all those objects that fall within the scope of C. In set-theoretical terms, it is all of the members of a certain class, C. The intension of C is a combination of essential, or jointly necessary and sufficient, criteria that each instantiation of the concept must have in order to qualify as C.

While the distinction between extensional and intensional definitions is sometimes useful (see, e.g., Lyons 1977), it is not, for various reasons, suitable for the classification of different kinds of definitions. I will list three reasons below.

First of all, these concepts are not fully mutually exclusive in every way. A definition that is intensional can also be partly extensional, e.g., by defining part of the criteria extensionally. For example, many definitions of privacy identify privacy as having something to do with control and/or limited access, but the thing which one should have control of, and/or limited access to, is sometimes defined extensionally (see, for example, Moore 2008).

Secondly, the concepts of extension and intension can also be used in another sense: as part of a grading of the descriptive adequacy of a (descriptive) definition. According to Anil Gupta there are three grades:

- extensional, intensional, and sense. A definition is extensionally adequate iff there are no actual counterexamples to it; it is intensionally adequate iff there are no possible counterexamples to it; and it is sense adequate (or analytic) iff it endows the defined term with the right sense.

(Gupta 2015)

Of course, on Gupta’s usages of ‘extension’, it is the actual, rather than the possible, extension of a concept that is indicated.

One problem with the subdivision of extensional and intensional definitions is that one risks missing the interaction between the extension and intension in a definitional process. It is partly presumed, e.g., in Paper II that secure information is such that we know it when we see it, i.e. that the extension of the concept is not contested, or at least
not contested beyond a point that makes counter-examples redundant. In philosophy, we do – on occasion – disagree about certain examples, but in many cases we are in agreement about a large part of the extension of concept. It is by comparing a proposal for necessary and sufficient criteria with such agreed-upon examples (and more contested ones) that we are able to see if the proposal has any “indisputable” (or disputable) counter-examples. (This is the process I discussed earlier, see p. 14.)

Lastly, although the classification is sometimes useful, the further classifications of definitional types, which I will expand on below, are orthogonal to that of intensional and extensional definitions. For the above reasons I will stick to the standard classification.

Now, amongst the real and nominal definitions we can identify a few different definitional types. I will explicate the major ones briefly below.

**Lexical or dictionary definitions.** Lexical and dictionary definitions are nominal. Lexical definition report the meaning of a word as it is commonly used. It is common to classify dictionary definitions as lexical definition, although dictionary definitions sometimes do not precisely, nor exclusively, report the common usage, but are prescriptive to some degree, e.g., by (more or less) correcting mistakes which have actually become common usage (cf. Robinson 1950, Gupta 2015).

**Stipulative (or prescriptive) definitions.** Stipulative definitions are standardly nominal. They are simply, and strictly, pure stipulations. They are often used to introduce terminology that will be used in a particular context, such as by ‘x’ I will mean ‘…’. They are very similar to prescriptive definitions, which prescribe use (it is often the case that by saying by ‘x’ I will mean ‘…’ you also prescribe to the reader that they should use your stipulation). It is debatable whether a stipulative definition needs to be prescriptive in that sense. I will discuss questions relating to this issue further, in section 2.4. Other definitions, as exemplified by various dictionary definitions, are sometimes partially prescriptive. It is an interesting philosophical question – which I, albeit,
will ignore – whether real definitions can have a prescriptive element (cf. Gupta 2015, Robinson 1950, Harris and Hutton 2007).

**Descriptive definitions.** According to Gupta:

> Descriptive definitions, like stipulative ones, spell out meaning, but they also aim to be adequate to existing usage. When philosophers offer definitions of, e.g., ‘know’ and ‘free’, they are not being stipulative: a lack of fit with existing usage is an objection to them. (Gupta 2015)

That a descriptive definition “aim to be adequate to existing usage” (ibid) does not mean that they are lexical, the exact relation here is a debatable question. But it is minimally necessary that we aim at the same entity, e.g., water, as the colloquial use of the word ‘water’, does.

As previously noted (and quoted above), Gupta distinguishes between three kinds of descriptive adequacy: extensional, intensional, and sense.

Gupta uses the classical example of water as H₂O, which supposedly has no actual counterexamples. Further, supposing water is a rigid concept (in the sense of the Putnam/Kripke view) it has no possible counterexamples. Nevertheless, Gupta claims that the definition “is not sense-adequate, for the sense of ‘water’ is not at all the same as that of ‘H₂O’” (ibid). It is important to note how this conclusion relates to Gupta’s classification of descriptive definitions. He criticizes the sense adequacy of defining ‘water’ as ‘H₂O’ because it lacks the sense of the word, i.e. ‘water’; rather than the sense of the concept, i.e. water. But focusing only on the sense of the words ‘water’ and ‘H₂O’ betrays a relevant difference. Clearly, no-one would claim that ‘water’ is ‘H₂O’; although many may claim that ‘water’ is a name for H₂O, while others would claim that water is H₂O. Supposedly Putnam/Kripke held/holds the latter view (cf. Kripke 1980). The difference here is whether or not we focus on a descriptive definition that is nominal or real.

If there are real definitions, then there should certainly be real definitions which are also descriptive, i.e. real descriptive definitions. As
such real descriptive definitions (if successful) describe, most commonly a concept or a kind, while nominal descriptive definitions would describe a word. Real descriptive definitions are, arguably, the kind of definitions that, e.g., chemists are interested in. The definition of gold – in chemistry – is not a definition of the word (‘gold’), but of the actual thing (gold). Thus, while Gupta’s example focuses on the sense adequacy of nominal descriptive definitions, the sense adequacy of a real descriptive definition would focus on the sense of the concept, not the word.

While philosophers do, often, think that there is an important relation between common sense usage, or intuitions, of a word it is not always the case that such usage, or intuitions, supply counterexamples to a conceptions of the concept which a word supposedly expresses. This brings us to Carnap’s explicative definitions.

**Explicative definitions.** Explicative definitions are, in the words of its inventor/discoverer:

> explication consists in transforming a given more or less inexact concept into an exact one or, rather, in replacing the first by the second. We call the given concept (or the term used for it) the **explicandum**, and the exact concept proposed to take the place of the first (or the term proposed for it) the **explicatum**. The explicandum may belong to everyday language or to a previous stage in the development of scientific language. The explicatum must be given by explicit rules for its use, for example, by a definition which incorporates it into a well-constructed system of scientific either logico-mathematical or empirical concepts. (Carnap 1962: 3)

Arguably it is often the case when philosophers are doing descriptive definitions that they are also partly explicating a previous conception, or correcting the common understanding of a word/concept. In Paper II, one could say that we aim for a descriptive definition, but that we are also doing an explication (since we improve on previous conceptualization of security).
Explicative definitions can, arguably, be both real and nominal, depending on what we explicate (word or concept).

Ostensive definitions. Ostensive definitions are the kind of definition we use when the answer we give to questions like “Who is x?” is an action such as: *pointing to x*.

Ostensive definitions can arguably be both real and nominal, depending on whether it is a response to a question about what a word refers to, or what a concept is. An ostensive definition is arguably often a special case of an extensional definition, since it (most commonly) points to a particular extension of a word/concept, rather than to all of them. Sometimes, of course, with an addendum, e.g., red is that (*pointing*) kind of color.

While philosophically interesting, this is not a kind of definition that will be dealt with in this thesis. (Various philosophers have concerned themselves with ostensive definition, e.g., Wittgenstein 1953).

2.3 A selective history of the origins of the philosophical discussion on definitions and distinctions: and their (mistaken) relation

Definitions and distinctions have played an essential role in the history of philosophy at least since the days of Plato. In many of Plato’s dialogues he is seeking the answer to the question ‘what is x?’. For example, in *The Republic* he seeks the answer to what justice is, or what is just.3 Plato was seeking a real definition. He was not interested in the shadow meanings of our languages, but in the actual form of the fundamental concepts (see, e.g., *The Republic*). What Plato does in *The Republic* (and similarly in other dialogues) – at least in the sections in which the text is actually a dialogue, i.e. not a monologue – is to discuss various proposals of what justice is. *False* proposals are refuted, e.g., by

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3 This is not meant to serve as an interpretation of the main themes of *The Republic*, for one may argue that the search for the essential meaning of justice is merely a means to an end of presenting various theories.
pure counter-examples (because even if we might not know the intension of justice, nor the whole extension, we know part of the extension), or by introducing meaningful distinctions that shows that a proposed definition of one concept is actually a conflation of two, or more, concepts (cf. Plato 1997).

Despite aiming for (real) definitions, the philosophical work in many of Plato’s dialogues consists mostly in making distinctions. This does not, in any way, diminish the virtue of the philosophical contribution, since sometimes a lot of philosophical confusion is nested in conflation of distinct concepts. On such occasion, it may even be argued that distinctions often serve a more fundamental, and fundamentally important, role than definitions as such.

The focus on distinctions was echoed by Aristotle’s slightly more formal approach. In Porphyry’s *Isagoge (Introduction)* Porphyry aimed at introducing the fundamental logics of the old masters. Porphyry’s introduction is mainly an introduction to Aristotle’s predications, however, the standard scholarly interpretation seems to be that Porphyry thought that Plato and Aristoteles were pretty much in agreement: Porphyry’s “writings on Aristotle's logical works [---] contain attempts to harmonize Aristotle's logical writings with Platonism” (Emilsson 2015).4

The *Isagoge* explains the Aristotelean system of classification, in which a *genus* (a fundamental object) is subdivided into *species* (parts of a genus distinguished from each other by dichotomous properties). One specie (such as animal) can of course be a genus for another specie (such as man). Men, as a specie, however, are not a genus for anything, but under it are only *individual* men (such as Plato, or Socrates). While

4 I am not mentioning the *Isagoge* because I believe it to be the most excellent interpretation of Aristotle’s predications; on this I am silent. Rather, I use it as an example because it serves my purposes well and because it was an extremely influential text, serving “as a standard introductory text [to philosophy] in Byzantium, the Arabic world and in the Latin West through Boethius’ translations and commentary [---] for at least 1000 years” (Emilsson 2015, cf. Barnes 2006: ix).
Porphyry recognizes that there are different ways in which one thing can differ from another, and that various differences can be accidental, he, however, argues that:

divisive differences of genera are found to be completive and constitutive of species. For animal is split by differences of rational and non-rational, and again by difference of mortal and immortal; and the differences of rational and of mortal are found to be constitutive of man, those of rational and immortal of god, and those of non-rational and of mortal of non-rational animals. (Porphyry 2006: 10, 10:9-15).

The idea here is that what distinguishes one kind from another also gives us necessary criteria for that kind. But it is not evident that this is the case. For example, the demarcation between moral acts, on the one hand, and immoral acts, on the other hand, says nothing about the definition of (im)morality. Another example is that in Paper I I make the distinction between informative and non-informative information, a distinction which prima facie may seem counter-intuitive. Such a distinction, however, does not mean that these two different classes are defined by what distinguishes them. Thus, the classical Aristotelean/Porphyrian subdivision of genus into predicates does not necessarily give us defining criteria. Nevertheless, distinctions are central in philosophy and fundamentally necessary for definitions in the sense that if we cannot distinguish one thing from another, then – epistemically – there is nothing for us to define (even if there may be something ontologically).

2.4 Are there true and false definitions?

It is not uncommon to hear people claim that definitions – per se – are neither true nor false. Many who claim this, pre-suppose, that we are talking about stipulative definition. While it may be that it is strictly true that stipulative definitions are neither true nor false, that is not the case for other kinds of nominal definitions, e.g., lexical definitions. Clearly, a
definition that is supposed to report on how a word is commonly used can either fail to do so correctly (and thus falsely report on common usage) or succeed (and thus truly report on common usage). (A similar argument can be applied for the case of explicative definitions.)

Neither is it true about real definitions, which brings us to another issue; the hotly debated case of real definitions. I will turn to this issue shortly, but firstly I will present an argument for considering stipulative, or prescriptive, definitions – in many cases – as true or false by practice.

While the distinction between stipulative/prescriptive and descriptive definitions is prima facie meaningful, it is often the case that prescriptive (and stipulative) definitions also have a descriptive element. For example, if I write that in this work by the word ‘unkitolou’ I will mean ‘x’, then this is a prescriptive definition, i.e. I prescribe how ‘unkitolou’ ought to be used in this work (this is true for stipulative definitions as well, given the same kind of structure). However, this is also, arguably, implicitly descriptive to a certain extent. Now, it may be that I never use the word ‘unkitolou’ ever in this work, but that would be a special case (which this work is an example of). However, standardly, once a word is introduced by a prescriptive/stipulative definition, as exemplified above, then that word is used in the work. If this is so, the definitions is not only prescriptive (or stipulative), for it actually attempts to describe how the word is (or will be) used, not only how it should be used (or understood). Even if the formulation is particularly stipulative, such stipulations can, and should be, evaluated in the light of how the word is actually used and what is said of it, or what it refers to, in the work. As such, there could be a conflict between the descriptive elements in the so-called prescriptive/stipulative definition and the way the word is used in its prescribed/stipulated context. This is something which, arguably, could be true or false.

However, the idea that stipulative or prescriptive definitions are neither true nor false seems quite sensible given various examples of the freedom of stipulation, such as the fact that it is unproblematic to use the name ‘George Bush’ to designate a specific blue t-shirt. Thus, clearly
stipulative definitions are free from truth-values of real-world correspondence. But, if one – after prescribing the stipulative definition of George Bush – claim that the color of George Bush is red, then something is clearly off. Thus, just as lexical definitions must be externally valid, prescriptive/stipulative definitions must be contextually valid. Or alternatively, we may say that the externality by which we evaluate the validity of a prescriptive/stipulative definition is given by the definition and/or the context of the definition. For example, if I write in this licentiate thesis I ‘x’ will be used for ‘y’ then the external entity, to which it must correspond, is the licentiate thesis. Any definition must be, so to speak, true-within-the-story. Prescriptive/stipulative definitions just happen to have a more limited story than, e.g., descriptive definitions.

Thus, if stipulative definitions are prescriptive, and if the word/concept being defined is actually used, then there is potentially a do as you do/do as you say dilemma. In what way has an author whom does not stick to her stipulation failed? Certainly there seems to be an inconsistence of some kind. The question is whether we can make sense of this inconsistence without classifying the stipulation as false. I guess this can depend on the precise formulation that is used when presenting a prescriptive, if an author says that:

(1) in this text I will...

Then a claim such as (1) can of course be false. Now, there may be formulations that strictly avoid such an implication, but if I am right there are in most cases (minimally) an implicit claim similar to that of (1).

In this sense a stipulative or prescriptive definition is true/false. It is, however, not true/false in the sense that it is a true descriptive definition of the word/concept that it stipulates; rather it is true/false in so far as the limited claim it makes, within its given scope and context, is true/false.
Furthermore, presuming that certain things are impossible, with the caveat that I do not intend to define some impossibilia, then a definition of ‘x’ as a round square is also problematic. All definitions, even stipulative/prescriptive ones, must be internally valid (i.e. not contradictory in themselves – what we mean by a contradiction is relative to what logical system we choose and the context of the prescriptive definition).

Thus, if I am right, most definitions are true/false. However, they may be true/false in different ways – for example, they may be a true/false stipulation of how a word, or concept, is actually used in a context specified with the stipulation/prescription.

2.5 Are there real definitions?

Many have found the idea of real definitions perplexing and ultimately many have been convinced that there are no real definitions. For example, Robinson (1950) argues that the class of real definitions is empty. His argument is that all the practices (he can think of) that have supposedly been a practice with the aim of supplying real definitions have actually been confused applications of other activities (see ibid: 189f for a summation of twelve such activities). But although a lot of different activities that have been sub-sumed under real definitions have been partly confused conflations of other activities, it does not follow that there are no real definitions. Robinson’s argument is of course written prior to the well-known Kripke/Putnam example of H_2O. This example is not uncontroversial. Especially since Kripke did not focus on the question of defining water, but whether water have some essential and/or necessary properties. One can criticize the scientific definitions for various reasons (e.g., because we can question what delimits some natural kind). Such examples are philosophically less interesting, since the example is commonly used under the caveat of scientific correctness. One can also question whether science corrects our conceptual usage, i.e. when a discrepancy is discovered. For example,
according to Joseph LaPorte ‘jade’, ‘yü’, is used in China as a name for two different chemical compositions (see LaPorte 2004: 95f). While LaPorte offers an interesting criticism of Kripke/Putnam I am not interested in the semantic issues here, but whether we can define real objects and/or concepts.

More interesting is the classical Quineian criticism that modal notions require essentialism, which is a no-go according to Quineians. Certainly, the issue on whether there are real definitions hangs on the (real) definition of real definitions.

Contrary to the Lockean supposition we could argue that real definitions need not suppose any essentialism. If they are purely definitions of entities, by entities, essentialism only follows if we suppose that entities have essence.

The question hangs, at least partly, on what we take ‘essence’ and ‘necessity’ to mean, and whether these can be meaningfully defined without each other in a way which would satisfy the Quineian criticism. This is not something, which we can expand on here. However, José A Benardete have suggested how to create a real definition that – at least theoretically – should satisfy Quine:

Start with a nominal definition of the word ‘mountain’ or better, perhaps, a geological account of what it takes for something to be a mountain in the vein of Kripke and Putnam (should that be available), reformulate it in four-dimensionalist terms, and a real definition of mountain will have been produced. (Bernardete 1993: 271)

Denying that real definitions pre-suppose some form of essentialism would, if it is convincing, make the claim that there are real definitions (e.g., in sciences such as chemistry) less controversial. Whether these are natural kinds and definable by essential properties is a different, but perhaps a related, topic.

Another kind of question is how we can know that x is a real definition of y. In a critique of real definitions there is a risk of conflating the ontological thesis that there are (no) real definitions, from the epistemic thesis that we may, or may not, be able to know if the
definitions are right or wrong. The epistemic issue is a practical problem, which can be avoided in the current discussion by caveats such as: unless we are wrong about the scientific findings H₂O is jointly necessary and sufficient criteria for something to be water.

However, philosophy deals with concepts rather than objects, and how can there be real definitions of concepts? One may grant a minimal conceptions of real definitions – in terms of jointly necessary and sufficient criteria – for the objects which science concern itself with, while still arguing that philosophy often deals with concepts that cannot be studied in the same way as the objects of science.

But if we take a Popperian extremist position then surely philosophy is not in a much worse situation than science. We find corroboration by the extension of the concept, just as science finds corroboration from its experiments. We are able to falsify a conception of some particular concept by establishing that there are sufficiently convincing counter-examples, just as science can put a theory or hypothesis to a test and show that its predictions do not hold (cf. Popper 1959.)

This is also the very reason why we need to think about the application of a concept under conditions that are different from the current context. A real definition is not one that merely corroborates the historical extensions, but one that holds in any future situation. But philosophically we are just as stuck in Goodman’s “New Riddle of Induction”, as the inductivist is (see Goodman 1954).

Another concern is of course the question of whether there is such a thing as, for example, a secure state. Granted that no information – in practice – is ever absolutely secure we may question whether there is a meaningful concept of absolute security. On the other hand, we know that there is a state of the world such that some information is secure (even if not absolutely secure), and that is, arguably, something which can be expressed by a meaningful concept. In the same manner as we knew there was water before we knew that water is H₂O, even though there was – in practice – no (or, at least, rarely any) pure water (pure H₂O)
before distillation processes. Furthermore, on many occasions, we have reliable intersubjective information about the extension of various concepts such as security, i.e. we agree on particular cases whether it is secure or non-secure. The extensions therefore supply a test for the intension of the word, i.e. for the definition of the intension, granted that we are right. Now such a caveat (‘granted that we are right’) may seem like hand-waving, but how different is the situation from intersubjective (dis)agreement(s) about the extension of water? A real definition either matches all such cases or needs to be complemented by explanations why some intuitions are wrong, irrespective of whether it is a real definition of a concept investigated by science or by philosophy.

Harris’ and Hutton’s critique of real definitions is quite dissimilar from Robinson’s. *Pace* Robinson, Harris and Hutton connect real definitions with the Lockeian notion of ‘real essence’, and the belief that “when all erroneous beliefs are set aside, there is a definable reality that can be known and stated” (Harris and Hutton 2007: 42). Harris’ and Hutton’s criticism follows from the conflation between what *is* and what *can be known* (ibid: 42f), for example, see the quote below:

> For there can be – in our view – no ultimate assurance that human knowledge has reached a point where ‘real essence’ are finally revealed and understood; consequently, no guarantee either that ‘those sensible qualities which serve us to distinguish’ one kind of thing from another and give names to them actually ‘flow from’ any real essence. Both these assumptions are no more than acts of faith about the way the world of Nature is constituted and related to human language. (ibid: 43)

Instead of suggesting – like Robinson – that we should abandon the notion of real definitions, Harris and Hutton suggest that real definitions ought to be a list of all scientifically known properties of a certain type of thing found in nature. Their belief is that this approach frees us from the “metaphysical trappings” (ibid). It is contestable, however, whether identification or qualification of one thing as a type is a not a metaphysical endeavor, but then Harris and Hutton cannot
escape the metaphysical trappings. Furthermore, the idea that a long list of properties belonging to x counts as a definition of x is somewhat confusing. (One may compare with extensional definitions, which supplies a list of all objects that fall under the word/concept, but this is a list of all properties that fall under a specific type. One may ask what, if any, is the limit of the scope of such properties, clearly there are all kinds of superfluous properties of gold that science could discover, such as list of every person known to ever have owned gold.) More to the point, just because we are fallible it does not follow that we ought to give up the notion of real definitions. As far as I know, science may very well have been wrong when they determined that water was H₂O, confusing water with another chemical substance, but that is no argument against a real definition of water. That debate must indeed be a metaphysical one.

Harris and Hutton go on to claim that when it comes to concepts such as democracy, or honesty, it becomes somewhat more complicated. Their claim is essentially that “[t]here is no empirical investigation of democracy or honesty that parallels the investigation of natural substance like gold” and that “[w]ithout a prior definition of democracy or honesty, the research could never get started” (ibid: 44). Harris and Hutton conclude that these attempts at real definitions are merely “definitions of words” (ibid: 45).

But is this true; are there no empirical investigations as Harris and Hutton argue, do we really need a definition to get started, and why is that a problem? My response is quite simple. As I claimed previously, when we define concepts, such as security, we compare it against the extension of the concept, something that may be known without a prior definition. A first definition of a concept need not be purely stipulative, it need not be a complete fumble in the dark. Clearly, we have something to test against and to reason about. Take the example of fish. Although I may not know the scientific definition of fish, I can determine quite well what is and what is not a fish. More curious cases, such as whales or lungfish, have to be discussed and further qualified
(cf. Mill 1974 for an early discussion on the concept of fish vis-à-vis whales, e.g. p. 716). Just because everyone will not be satisfied with every pro- or counter-example for, or against, a proposed definition, that does not make it the case that the only matter we can resolve is stipulative, or about the meaning of words. (The same argument arguably applies to more abstract concepts, such as security.)

Needless to say, just because we use words to communicate definitions it does not follow that they are about words. Words like ‘democracy’ or ‘honest’ are just combinations of symbols, which certainly have an etymology. However, as philosophers we are rarely interested in the exact truth about the historical usage of a word, but rather whether that approximate notion that is indicated by the word can be explicated in a sensible way that seems to capture a concept that can be properly defined. If it is defined as, e.g., a state of affairs, then if such a state of affairs is or can exist then it is a concept, and that concept can have a real definition.
3. Semantic information

In my first paper, I discuss the concept of information, specifically in the context of a semantic conception of information. In particular, I argue against Luciano Floridi’s arguments for the veridicality thesis (the idea that [semantic] information necessarily must be true [truthful]).

It should be noted that it has been questioned by some whether we need a concept of semantic information (cf. Adriaans 2010, cf. Floridi 2010: 259ff), but irrespective of that it is clear that the work of Floridi have had great effect on the discourse. It is thus, simply for that reason, worthy of a critical discussion. Also, Floridi himself motivates the focus on semantic information by characterizing it as “the kind of information which is essential for epistemic purposes” (Floridi 2011: 82). Floridi’s characterization clearly makes the concept of semantic information worthy of consideration.

In this section, a brief context for Paper I is provided in section 3.1. Next, in section 3.2, I will briefly summated Paper I. Lastly, on the basis of the two previous section, I will briefly, and incompletely, discuss the relation between information and semantic information, in section 3.3.

3.1 Background and context

The concept of semantic information was introduced by Bar-Hillel and Carnap in the 1950s (cf. Bar-Hillel & Carnap 1964 and Bar-Hillel & Carnap 1953). It was introduced in a context dominated mainly by approaches to information that viewed the semantic issues as a non-issue.

Amongst the various conceptions of information, there are – according to Pieter Adriaans – at least six types:

1. **Fisher information**: the amount of information that an observable random variable $X$ carries about an unknown parameter $\theta$ upon which the probability of $X$ depends (Fisher 1925).
2. **Shannon information**: the entropy, $H$, of a discrete random variable $X$ is a measure of the amount of uncertainty associated with the value of $X$ (Shannon 1948; Shannon & Weaver 1949).

3. **Kolmogorov complexity**: the information in a binary string $x$ is the length of the shortest program $p$ that produces $x$ on a reference universal Turing machine $U$ (Solomonoff 1960, 1964a,b, 1997; Kolmogorov 1965; Chaitin 1969, 1987).

4. **Quantum Information**: The qubit is a generalization of the classical bit and is described by a quantum state in a two-state quantum-mechanical system, which is formally equivalent to a two-dimensional vector space over the complex numbers (Von Neumann 1955; Redei & Stoeltzner 2001).

5. **Information as a state of an agent**: the formal logical treatment of notions like knowledge and belief was initiated by Hintikka (1962, 1973). Dretske (1981) and van Benthem & van Rooij (2003) studied these notions in the context of information theory, cf. van Rooij (2004) on questions and answers, or Parikh & Ramanujam (2003) on general messaging. Also Dunn seems to have this notion in mind when he defines information as “what is left of knowledge when one takes away believe, justification and truth” (Dunn 2001 pg. 423, 2008).


As can be seen in Adriaans’s short descriptions above, a lot of the different conceptual approaches to information focus on measurements of informativity. This was the case for Bar-Hillel and Carnap as well, and the same can be said to be true of Floridi as well. One of the main distinctions that I make in Paper I is to point out that the property of being information is separate from the property of being informative (i.e. all information is not necessarily informative). Although it may
seem like a minor point, it is an important point on which definitional issues rest, and a point on which it has arguably been some confusion.

The fact that so many approaches to information are linked to informativity makes it plausible to argue that Paper I is valuable beyond the discussion of semantic information. However, the question of its wider applicability has partly to do with the relation between semantic information, on the one hand, and information, on the other hand. This is one of the questions that for spatial reasons have been neglected in Paper I, which is something that will be discussed briefly below. However, before that I will first sum up the main threads of Paper I.

3.2 How should we define semantic information?

The question in Paper I is broadly the question of how we should define semantic information. The specific focus, however, is on one criterion alone, that of truth or truthfulness. What I do in Paper I is to argue against the veridicality thesis (the thesis that [semantic] information must be true/truthful). I do that by presenting arguments in favor of an alethically neutral conception of semantic and arguments against a veridical conception of semantic information. The latter argumentation begins with an attempt to show that a veridical conception of semantic information leads to pure inconsistencies or counter-intuitive results. This is done by adapting a point I previously made in Lundgren (2015c,d). I show that if we adhere to the veridicality thesis then there are sentence that are semantic information if, and only if, they are not semantic information.

Next, my arguments in defense of a neutral conception of semantic information aims to show how Floridi’s counter-arguments can be defeated or solved. Firstly, I deal with Floridi’s so-called ‘splitting test’ which aims to show that ‘false information’ is not information, which is false, but not information at all. I argue that this test fails for various reasons. For example, part of Floridi basis for the test is that
‘false information’ is like ‘false alarm’, but clearly a false fire alarm is an alarm even if there was no actual fire.

Finally, I argue against Floridi’s semantic arguments, with the main focus on what he calls BCP (Bar-Hillel Carnap Paradox), which is the counterintuitive conclusion that false information is maximally informative. I argue that this can be resolved by distinguishing on the one hand between the property of being information, and on the other hand, the property of being informative. Contrary to the prima facie assumption, I argue that all information is not informative.

3.3 Semantic information vis-à-vis information

One of the questions that I leave untouched in Paper I is the exact role of semantic information vis-à-vis information as such. I will not be able to solve it here either, but I will sketch some preliminary distinctions.

Ignoring the potential difference between a semantic conception of information and semantic information (in which the former seems to indicate a genuine concept, not just something that can be conceptualized given some perspective) there are at least two fundamental ways we can think of semantic information.

First, if we accept Floridi’s characterization of semantic information as the kind of information that is essential for epistemic purposes then it seems most sensible to think of semantic information as a subconcept of information. Floridi does in fact treat it as a subconcept, since he recognizes what he calls ‘environmental information’ (e.g., rings on a tree trunk, see Floridi 2011: 91f). In Floridi (2016) he argues that:

One may be so used to see the low battery indicator flashing as carrying the information that the battery is flat to find it hard to distinguish, with sufficient clarity, between environmental and semantic information. However, it is important to stress that environmental information may require or involve no semantics at all. It may consist of (networks or patterns of) correlated data understood as mere differences or constraining affordances. Plants (e.g., a sunflower), animals (e.g., an amoeba) and mechanisms (e.g., a photocell) are certainly capable of
making practical use of environmental information even in the absence of any (semantic processing of) meaningful data. (Floridi 2016)

However, it does not follow that environmental information lacks meaning in a semantic sense, just because the environment does not have a semantic processing of that data. On the other hand, Floridi have various examples of information, which is contrary to the declarative notion he takes to be essential for epistemic information, such as orders (cf. Floridi 2011: 83).

Secondly, contrary to that of Floridi (and the approach I take in Paper I) is that of Fred Dretske, who thinks that “Although information, as ordinarily understood, may be a semantic concept, this does not mean that we must assimilate it to the concept of meaning” (Dretske 1981: 42). Under Dretske’s analysis it could certainly be the case that all information is semantic, but such a conception of semantic information is very different from the approach I share with Floridi, that semantic information is necessarily linked to meaning.

Now, supposing that semantic information is alethically neutral as argued in Paper I. One may then ask what criteria define such a concept. Since meaningfulness is taken as a fundamental property, the question is then which other criteria that must be added to make that minimal requirement jointly necessary and sufficient. I will here ignore the discussion on the criteria necessary for the achievability of meaningfulness (arguable, there must be something, e.g., data, for there to be meaning). Given that we accept an alethically neutral conception of information the interesting question is if meaning (and those criteria that are necessary for meaning) is sufficient or if semantic information also requires truth-values.

It seems that the exclusion of environmental information hangs on this issue. Concentric rings on a tree trunk may be meaningful, it may be used for epistemic reasons, but it is not declarative. It is not the kind of information that we assign truth-values too. The concentric rings are

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5 Floridi (2005) discussed the concept of DOS-information in, i.e. declarative, objective, semantic information (Floridi 2005: 352).
neither true nor false; although we could rephrase the information gained from the tree trunks in declarative terms.

If I am right that semantic information is alethically neutral, then the interesting question is what concepts of information are of interest and how they should be defined. In particular, there seem to be two competing conceptions of semantic information. Firstly, a minimal conception according to which meaning is necessary, but truth-values are not (on such a conception of semantic information environmental information is semantic). Secondly, a stronger requirement is that we need meaning and truth-values (on such a conception of semantic information environmental information is not semantic).\(^6\)

I will not argue for any of the above alternatives. However, what is clear is that the definition of semantic information affects other information concepts as such. Therefore, the whole plethora of information concepts ought to be considered when discussing the relation between semantic information and information.

\(^6\) It is interesting to note that that Floridi in his argument for the veridicality thesis only seems to formally consider the former conception (cf. Floridi 2011: 84), although he has already excluded environmental information.
4. Information Security

In this section, I begin with supplying the background and context of Paper II, which is co-authored with Niklas Möller, in section 4.1. The focus in section 4.1 will be on the standard definition of information security, which will then be followed some examples of previous criticism of the standard definition (4.2.), our criticism (4.3), and our proposal for a new definition (4.4). I will then discuss our proposal in light of the concept of resilience, in section 4.5. The purpose of this discussion is to give a brief example (or at least a sketch) of the generality and applicability of our proposal.

4.1 Background and context: the CIA definition

The standard definition of information security – which can be found in standards, handbooks, articles, legal codes, etcetera – defines information security in terms of three basic properties: Confidentiality, Integrity, and Availability (see, e.g., ISO 27000, 44 U.S.C. § 3542 – Definitions, Bishop 2005:1, Peltier 2001:4, Parker 1998:230). To these properties other properties are sometimes added, but it is in virtue of the triad the three basic properties that these kind of definitions are called CIA-definitions. These properties, which make up the CIA-triad, have been somewhat stable since at least the 1980s (see, e.g., Meijer et al 2007: 641).

As mentioned in section 2 ‘information security’ may refer to many different things. For us it is clear that the most interesting question is the question of when some information (system) is secure. In many standard definitions it is evident that CIA definitions are used to define just that, even though there are – as noted in Paper II – a lot of disagreement about the exact role of the CIA triad and the CIA definitions (cf. Paper II: 82, fn. 12).

Thus, in order to discuss the CIA definition critically we must first specify it. Our specification has two functions. Firstly, we contextualize
it be arguing that the aim of the definitions (the vast majority, or at the very least the examples we mainly address) is to define a state when some information is secure. Secondly, we formalize the definition so that it fits the standard formula for a definition:

The CIA definition of secure information: some information I is secure if, and only if, all parts of I retain the properties of confidentiality, integrity, and availability (where these properties are further characterized as given in the ISO-definitions [...] (ibid: 83, italics in the original)

4.2 Alternatives and previous criticism of the CIA-definition

Just as there is a lot of disagreement about the exact role of the CIA-triad, there is also a lot of previous criticism of the CIA-definition of secure information. A standard form of criticism is the idea that the CIA-triad is insufficient, but can be complemented by other properties. For example, Parker (1998), presents a few actual cases of security breaches/incidents that he argued where not cases of breaches of confidentiality, integrity, or availability. To resolve this, he adds three more criteria: Possession / Control, Authenticity, and Utility (see Parker 1998, 2009). It is not uncommon to discuss whether the CIA-triad needs to be complemented by other properties. In standards such as the ISO-definition, this is recognized by the following formulation: “In addition, other properties [...] can also be involved” (ISO 27000: 5).

There are various examples of proposals to complement the CIA-triad, or to switch out some of the three basic properties for other properties. However, these kinds of criticism are of less interest since our counter-examples against CIA-definitions aims to show that these types of definitions are analytically wrong – security is not a matter of

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7 In the upcoming examples (section 4.3, Paper II: 85-91) we discuss both when an information system or some information is secure. Although both is of interest we have merely specified CIA related to the latter. Our examples, however, are such that if the system is unsecure the information is unsecure too.
satisfying a specified list of properties; at least not in this colloquial sense.

More interesting are proposals that suggest other approaches to security, such as that of James M. Anderson:

I propose the following definition of enterprise information security: A well-informed sense of assurance that information risks and controls are in balance. (Anderson 2003: 310)

Anderson’s definition is interesting, but – amongst other problems – it is an example of a conceptual confusion of the ontological state of a thing (security is, arguably, a state of affairs) with the question of what we know about that state (having a well-informed sense of assurance is, arguably, an epistemic notion). Arguably, something can be secure even if we do not know that it is. On the other hand, an epistemic conception of information security is – of course – not without interest. However, once we know what security is (ontologically), the epistemic conception can be defined relative to the ontological.

4.3 Our critique of the CIA definition

Our criticism is two-fold: we aim to show that the CIA-definition (henceforth characterized by the previous specification) neither supplies necessary, nor sufficient properties for the state of security of information. Thus, the CIA-definition fail both by being both too broad (characterizing non-secure states as secure) and too narrow (characterizing secure states as non-secure).

I will give a brief and selective summation of our arguments, starting with the former, i.e. the false negatives. Consider, e.g., availability – the property that information be timely available to authorized users. Now, there are security systems that depend on removing the property of availability to increase security. One such example is time locks. The whole idea of time lock is to make the locked-away content unavailable even to authorized users. This means
that availability cannot be a necessary property for a secure system, but according to the CIA-definition availability is a necessary property.\footnote{It is fairly well-known that the CIA-triad in practice may be in conflict, i.e. protecting confidentiality and integrity may result in more lacks approach to the property of availability (cf. Pfleeger & Pfleeger 2007: 10). In practice this may be resolved by prioritizing one property over the other, but this does not save the definition as such.}

That some secure information is defined as non-secure shows that the CIA-definition has identified various properties as necessary, although they are not. A more serious problem, however, is defining unsecure information as secure, i.e. false positives. The CIA-definition suffers from false positives because it has conflated serious consequences of a security breach with the state of non-security, which is a problem since it is not the case that all security breaches have serious consequences.

Consider the following example: a system administrator has all possible forms of access to a system and the information contained within that system. Now, imagine that someone takes the system administrator’s children as hostage. At this moment it may very well be the case that the properties of confidentiality, integrity, and availability are all retained. However, the system is, of course, not secure, since the hostage taker has influence, and/or, control over the system administrator. This is the security breach, but according to the CIA-definition secure is only breached if and when the hostage taker forces the system administrator to do something such that the properties of CIA are actually affected.

Our analysis of these kinds of problems boils down – more or less – to the idea that security is relative to the needs of, e.g., some certain organization, information, or information system. In lieu of this we propose a new kind of definition. To this we now turn.
4.4 Our proposal for a new definition of information security

We argue that what we need – in order to resolve the problems for the CIA-definitions – is a definition that is contextually sensitive. We therefore propose a definition of security such that:

RIGHT (general): The object $O$ is secure iff: For every agent $A$ and every part $P$ of $O$, $A$ has just the right access to $P$ (Paper II: 92, italics in original).

If applied to some information/system we get:

RIGHT (information): The information $I$ is secure iff: For every agent $A$ and every part $P$ of $I$, $A$ has just the right access to $P$.

RIGHT (information system): An information system $S$ is secure iff: For every agent $A$ and every part $P$ of $S$, $A$ has just the right access to $P$ (ibid: 92f, italics in original).

Agent is any entity (technical, software, human etc.) that may have some kind of access to some part of the object.

It may seem that the definition is stating only the obvious – i.e. that access relations should be just right. However, the idea of this definition is that it needs to be further applied either to the context (an option we discuss, but do not further analyze in the paper) or to the needs of some specific stakeholder (e.g., an organization). The basis of this is, as I noted previously, that security is relative.

Thus, what one needs to do in order to use the definition is to apply the definition to the specific needs of that stakeholder. In order to do this one needs to determine the relevant access to any agents for all part of the stakeholder's information. The definition does not only capture that what is right is relative, but also that these things can change over time.

This is part of the benefit of our proposal: that it requires those who apply the definition to think about (all) the relevant aspects of security and how it is achieved.

This can be phrased in many ways. In order to expand on the ideas of the paper I will now turn to addressing these kinds of benefits of our proposal in terms of resilience and the design of resilient systems.
4.5 Information security from the perspective of resilience

Resilience is a concept that perhaps is more commonly used in the context of safety management, rather than security. However, the concept of resilience is nevertheless of some interest also when it comes to retaining security. As with many other terms, the definitions of the term vary, but the common core idea is that a system is resilient if it can withstand severe changes, minimize catastrophic outcomes in extreme scenarios, and in case of damage that it can quickly return to its normal (or a sufficient) functionality. For example, Erik Hollnagel has proposed the following definition (in relation to safety management):

A system is resilient if it can adjust its function prior to, during, or following events (changes, disturbances, and opportunities), and thereby sustain required operations under both expected and unexpected conditions. (Hollnagel forthcoming 2017)\(^9\)

Such a concept is of course useful in the discourse of security in general and information security in particular. It is also evident that the definition we propose is helpful in the design of resilient system:

If we want to create, and retain, a resilient system that is secure then we need a definition of security that is sensitive to the specific needs and challenges for that particular system. (Lundgren 2015b)

By applying our proposed definition in the design and management processes one must keep in mind that what is right is not only contextually sensitive to current needs, but also future needs. Thus, for example, even if we do not currently have any sensitive information, in a possibility were we do we must be able to properly handle access to such information so that the access remains just right (cf. Lundgren 2015b).

\(^9\) The manuscript lacks pagination.
References

44 U.S.C. § 3542 – Definitions


ISO/IEC 27000 2012E


