Defeasible Classifications and Inferences from Definitions

This paper shows how classifications and definitions can be used to construct different patterns of logical reasoning called defeasible argumentation schemes, often identified with heuristics, or short-cut solutions to a problem. We show how it is possible to argue reasonably for and against arguments from classifications and definitions provided the arguments are seen as defeasible. We examine a variety of arguments of this sort, including argument from abductive classification, argument from causal classification, argument from analogy-based classification and arguments from classification based on generalizations.

Classification of reality is a complex pattern of reasoning essential for communicating and making decisions. Naming reality is a reasoning process relating concepts, and therefore a representation of reality (Sager 2000, p. vii). The most basic type of reasoning from classification is the argument from definition. Definitions, and especially definitions used as premises in reasoning from classification, represent a "special sort of social knowledge" (Schiappa 1998, p. 1), a form of common knowledge constituting the semantic system of a community (Rein, 2000, p. 5). Reasoning from definition is a form of argument grounded on what was shown by Aristotle to consist in an equivalence between the defined name and the discourse explaining what it is (*Topics* I, 5). In an enthymeme proceeding from definition, the major premise is the shared definition of a term, while the minor presents a set of features by which an object is characterized. For instance, let's consider a classic philosophical case argument by definition.

> Man is a reasonable animal
> This entity is an animal and is reasonable
> Therefore it is a man

The major premise (the first one) can be taken to be a general definition (put forward by a philosophical school of thought), whereas the minor premise fits an entity into it. In previous papers on definition and classification (Macagno and Walton 2008, 2009), we worked on problems concerning the nature and implications of the major premise in reasoning from classification. However, not only might the major premise be controversial, but also (and this is what happens in many cases) the minor premise, which expresses a factual judgment, can also be subject to doubt. For instance, even if we take for granted that a man is a reasonable animal, several problems can arise from the way we can classify something as "reasonable" or as "animal". Is an animate being that can make simple calculations a man? Controversies may arise at a deeper level of reasoning, namely at the stage where the features considered as requirements for the attribution of a property are predicated of an entity.

We will show that although the strongest type of reasoning from classification is deductive, this type of classification is often useless, especially when a new entity is to be named according to factual observations within a limited span of time. Here, we will show, heuristics, shortcuts that lead to suboptimal solutions to a problem, need to come to the fore. These shortcuts will be associated with defesaible argumentation schemes. In this paper we will inquire into a variety of commonly used types of argument based on classification and definition. Argument from classification, as conceived in (Walton 1996, p. 54), can be described as the attribution of a property to an entity on the basis of a classification. This argumentation scheme is extremely broad, as it encompasses

deductive, abductive, and analogical patterns of reasoning. Often judgments have to be made in conditions of uncertainty, lack of time and lack of knowledge, conditions where heuristics are useful. In these cases, as we will show, other types of link between the classification and the property are used to warrant the conclusion.

1. Arguments from classification

To begin this section the most important point to be made is that many of the most common arguments used to argue to or from classifications and definitions have an underlying form of inference based on a major premise, or warrant, to use Toulmin's term,[1] that is a qualified generalization. Such a generalization is subject to exceptions, and hence the argument based on it is defeasible. This means that the argument can default if it is found that the case in point constitutes an exception to the rule. Such reasoning typically takes a form of argument studied in (Walton, 2004, chapter 4).

Defeasible *Modus Ponens*

MAJOR PREMISE: Generally, but subject to exceptions, if something has property *F*, you can also expect it to have property *G*.
MINOR PREMISE: Object *a* has property *F*.
CONCLUSION: Therefore object *a* has property *G*.

This form of argument is called defeasible *modus ponens* (DMP), as opposed to the deductively valid form of *modus ponens* that is so familiar in deductive logic: if *A* then *B*; *A*; therefore *B*. DMP is a special subtype of *modus ponens* argument that applies to defeasible arguments.[2] DMP is a common form of argumentation in argumentation, especially in reasoning from a classification or concluding to it.

The etymology of the term 'defeasible' comes from medieval English contract law, referring to a contract that has a clause in it that could defeat the contract in a case where special circumstances fit the clause. However, the origin of the term in modern philosophy is a paper called 'The Ascription of Responsibility and Rights' by H. L. A. Hart (1949; 1951). According to Hart, defeasible claims can be challenged either by a denial of the facts upon which they are based or by a plea that circumstances are present which brings the case under some recognized head of exception (1951, 147-148). Hart also showed that defeasible reasoning arises from the use of defeasible concepts (1961), using his famous example of the rule that no vehicles are allowed in the park. This rule could be defeated by issues of classification. For example, a car is classified as a vehicle, but what about a bicycle? Is it a vehicle? Both sides could be argued, in the absence of a law making a specific ruling. The best way of dealing with such disputes, we will contend, is to view arguments based on classification as defeasible.

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[1] Toulmin (1964, pp. 103-107). Toulmin clearly saw inference warrants as defeasible in his model of argument. He expressed the conclusion using the wording "so, presumably", basing it on an inference containing an "unless" qualifier. Meeting the qualifier by showing that there is an exception to the warrant defeats the inference to the conclusion in Toulmin's model (p. 105).
[2] Verheij (2003) has recognized DMP as a form of argument widely used in legal argumentation.

The concept of classification has to be distinguished from what has been called argument from classification. Classification can be conceived as the process of attributing a name to an entity, and is a semantic notion. Argument from classification is a pattern of argument that merges the semantic principle, that is, naming an entity, with a form of logical inference, such as DMP. The first argumentation scheme from classification can be found in Hastings (1963, pp. 36-52):

Argument from Criteria to Verbal Classification

MAJOR PREMISE: If *x* has characteristics A, B, C… then *x* is Q
MINOR PREMISE: Event or object X has characteristics A, B, C…
CONCLUSION: Therefore, event or object X is Q.

This scheme turns the logical form of inference DMP into a more specialized type of argument, by making the major premise, which has the form "If p then q", apply to an event or object cited in the minor premise. The formal variables are specified through the concepts of "characteristics" and "property". This scheme has been developed by Walton (1996, p. 54), and the semantic link between premises and conclusion has been made more explicit. In the following version of the scheme the major premise (stated as the second premise in this version) specifically states that the semantic link is a classification, even though it does not specify how the entity can be classified:

MAJOR PREMISE: For all *x*, if x has property *F*, then *x* can be classified as having property *G*.
MINOR PREMISE: *a* has property *F*.
CONCLUSION: *a* has property *G*.

Such a scheme, however, is defeasible. The conclusion is grounded on two potentially controversial assumptions: the classification of *a* as *F*, and the principle setting forth the rule of classification. The first classification of *a* as *F* may need to be grounded on evidence. For instance, consider the argument 'This is an unidentified flying object; therefore it is an extraterrestrial spacecraft'. The first critical point is to determine on what grounds the thing that has been seen is an 'object' and why it cannot be identified. The second step in the reasoning, is to assess the acceptability of the relation between 'to be a UFO' and 'to be an extraterrestrial spacecraft'.

Even though the semantic principle has been clearly pointed out in this scheme, what remains unclear is why a property should be attributed to another on the grounds of a classification. Reasoning of the kind in (1) is clearly unreasonable.

(1) This object is white. Therefore it is a bag

But the following cases would be commonly accepted as reasonable and strong arguments.

(2) This object is a container of flexible material that is used for carrying or storing items. Therefore it is a bag

(3) This object is something which you can carry by hand and you can put stuff into. Therefore it is a bag.
(4) This object is used for baggage (*bagage*). Therefore it is a bag.
(5) This object has two handles and a sack. Therefore it is a bag.

The arguments (2), (3), (4) and (5) are reasonable because, contrary to (1), they are grounded on a specific semantic link between the qualities mentioned in the premise and the property attributed to the object in the conclusion. The link in those cases is definitional. The features that the object is claimed to possess are forms of definition of the property attributed to the object in the conclusion. Definition, on our perspective, shall be considered any discourse describing the meaning of a concept, which can be drawn, or better abstracted, from language use.

In order to account for the difference between the arguments above, the scheme from verbal classification has been developed as follows (Macagno and Walton 2008, p. 96):

MAJOR PREMISE: For all *x*, if *x* fits definition *D*, and *D* is the definition of *G*, then *x* can be classified as *G*.
MINOR PREMISE: *a* fits definition *D*
CONCLUSION: *a* has property *G*.

As noticed above, the nature of the conditional "if p then q" is necessary for explaining the difference between reasonable and unreasonable arguments. This scheme encompasses the logical principle DMP and the semantic rule, which establishes that the definition is interchangeable with the *definitum*. However, as noticed in the examples above, the conclusion may follow from a premise in virtue of different types of definitional propositions. In other words, several different types of implicit major premises are commonly considered as definitions. (2) is commonly considered to be the genus-species definition of "bag", that is, a definition showing the most generic semantic features, and the characteristics distinguishing the *definitum* from other concepts of a language. (3) is only a definite description, that is, a definition in which only the attributes proper for the *definitum* are pointed out, or some of its characteristic accidents. (4) is a definition by etymology, in which the *definitum* is described as relating to the word it historically stemmed from. (5) is a definition by parts, highlighting the parts the *definitum* is made of. The definitions (2), (3), and (4) are based on are commonly considered as convertible with the *definitum*, as they represent respectively its semantic structure, the attributes that can be referred only to it, and its etymology. In contrast, the definition by parts is not convertible; even if a bag has always two handles and a sack, two handles and a sack can be also something different from a bag. The parts in themselves (and not their specific connection, which would constitute a genus) can be conceived as signs that the object is a bag.

These arguments are different both from a pragmatic and logical point of view. From a pragmatic perspective, the argumentative usefulness of a definition depends on the context of its use and the knowledge it presupposes. An argument based on an essential definition can be used only when the essential features of the object are already known, that is, the semantic properties of the object are shared. For instance, in the case above, it is necessary to know that the entity is used for carrying items in order to classify it as a bag. In contrast, an argument based on a definition by parts can be used when only

physical evidence is given. For instance, even in cases in which the purpose of the object is unknown, it is possible to cite its physical characteristics. A definition from etymology leads to arguments from classification especially aimed at generating the possible implications of the already classified object (you are a counselor; therefore you have to advise, not to advocate).

From a logical perspective, it is apparent from the examples above how different definitions have different logical properties. An argument from genus-species definition (2) is always much stronger from a logical point of view than an argument from mereological definition (5). The former is deductive, and is based upon the meaning of the *definiendum*, which is the deepest level of knowledge the interlocutors have to share in order to understand each other. The latter, based on a definition which is not convertible, proceeds from an abductive type of reasoning. Arguments based on definite descriptions (3) can be deductive or abductive, depending on whether they are grounded on property of the object (such as "This being can whinny, therefore it is a horse") or simply on one or more of its accidents (such as "This object is used to carry items; therefore it is a bag"). Independently from the acceptability of the shared knowledge expressed by the definition, the propositional structure of the definition itself can determine the logical properties of the arguments proceeding from it. We represent the different logical properties of arguments from definition in table 1

Genus-species definition		Definition by parts	
This object is a container of flexible material that is used for carrying or storing items.	A	This object has two handles and a sack.	B
(A bag is a container of flexible material that is used for carrying or storing items.)	$A \rightarrow B$	(A bag is characterized by two handles and a sack.)	$A \rightarrow B$
Therefore it is a bag.	B	Therefore it is a bag.	A

Table 1: Logical Properties of Argument from Definition

A definition by parts is still a definition, as it establishes a sort of equivalence between two entities (a bag **is** two handles and a sack)[3]; however, as those characteristics are parts that the object is made of, we highlighted the logical difference between the essential and mereological statements using another predicate.

If we consider how different definitions characterize arguments grounded on different types of reasoning and different axioms, we notice how a semantic relation between premises and conclusion, that is a definition, can proceed from different logical types of reasoning.

2. Definitions and strategies of classification

[3] As Aristotle shows in (*Topics*, I 5), how propositions concerning sameness and difference can be considered definitions: «One may, however, use the word 'definitory' also of such a remark as 'The "becoming" is "beautiful"', and likewise also of the question, 'Are sensation and knowledge the same or different?', for argument about definitions is mostly concerned with questions of sameness and difference. In a word we may call 'definitory' everything that falls under the same branch of inquiry as definitions; and that all the above-mentioned examples are of this character is clear on the face of them».

Different definitions have different purposes; a genus-species definition is extremely strong, but is useful only in certain circumstances. Genus-species definitions can be conceived as stating the semantic features which distinguish an entity from the others within the same class. For instance, if we consider the concept of 'blackberry', the common definition is "large sweet black or very dark purple edible aggregate fruit of any of various bushes of the genus Rubus". Within the genus, or general semantic trait, of "fruit of bushes of the genus Rubus", specific differences are listed. However, the same word in wine lexicon does not fall under the genus 'fruit' but under 'flavor', and it is distinguished not from all the possible types of berries according to the nature of the bush of which it is fruit, but the paradigm of possible entities it is separated from comprehends only some berries, and other fruits like peach or pear. The concept of genus, in other words, is established on the basis of the use of the word to denote different concepts.

However, as genus-species definition is a semantic instrument, whose purpose is to describe the meaning of words, and not classify entities, it is constituted of abstract *genera* and differences, namely general and specific semantic features. How can we classify an entity when we cannot abstract its characteristic features from the visible signs? If we are not botanists, we could never tell a bush of the genus Rubus from another bush, nor can we individuate the balance of bitterness, sweetness, etc. describing the flavor "blackberry" if we are not chemists. In those cases, the shape and color, or the likeness of taste are criteria of classification which are not certain, but are efficient in conditions of lack of knowledge. Those features cannot describe the meaning of the term; however, they provide defeasible evidence for classifying an entity (see Clancey 1985, p. 14). This type of reasoning is called a heuristic, a temporary way of arriving at a suboptimal way of solving a problem that is fast and frugal. Heuristics can sometimes go wrong and be associated with fallacies, but are extremely useful in arriving at a decision under constraints of time pressure and lack of knowledge. Thus a classification can be a temporary way of moving ahead with making decisions about what to do, even though it may later have to be modified and made more complex, with more exceptions to rules (see Saks and Kidd 1980-1981 and Carson 2007, pp. 105-106 for the risks of heuristics). Here are three examples of such uses of argument from classification as heuristics.

Case 1.

In (Grundy 2005, p. 2741), "High risk patients" is defined as follows: "High-risk patients are those with established ASCVD, diabetes, or 10-year risk for coronary heart disease >20%. For cerebrovascular disease, high-risk condition includes TIA or stroke of carotid origin or >50% carotid stenosis". This definition clearly distinguishes high risk from low or very high risk, on the basis of the patient's medical history; however, if we ignore the patient's previous diseases, or his risk factor for particular diseases, we would be unable to classify him in a category. In the following example, a different type of classification is used to categorize a man rushed to a hospital while he is having a heart attack. In this case, the physician needs to decide under time pressure whether he should be classified as a low risk or a high risk patient. Using the decision tree shown in figure 1, heart attack patients can be classified according to risk using three variables.

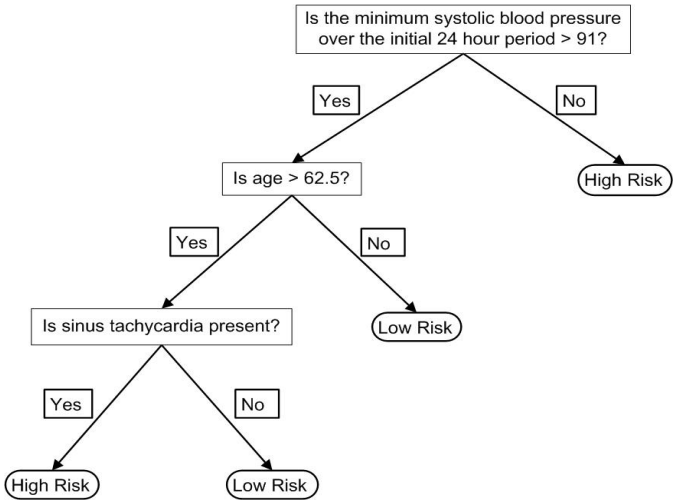

Figure 1: Example of a Heuristic Adapted from Gigerenzer et al. (1999, p.4).

The patient who has a systolic blood pressure of less than 91 is classified as high risk without considering any other factors. A patient under age 62.5 is classified as low risk. If the patient is over that age, the additional factor of sinus tachycardia (heart rhythm of greater than 100 beats per minute) needs to be taken into account. This decision strategy is called fast and frugal by Gigerenzer et al. (1999, p. 4) because it does not involve much computation, and only searches some of the available information. It is very simple and ignores the mass of quantitative hard information, and therefore it makes us suspicious that it might be inaccurate compared to a statistical classification method that takes much more data into account. However, according to Gigerenzer et al. (1999, pp.4-5), "it is actually more accurate in classifying heart attack patients according to risk a status than are some rather more complex statistical classification methods". In this example, patients are not classified according to the features distinguishing a risk factor from the other, but only using some shallow diagnostic evidence.

Case 2

Another example is given from a program (GRUNDY) analyzed in (Clancey 1985, p. 9) aimed at classifying book preferences on the basis of a person's characteristics. This program categorizes people in classes according to their jobs or habits. For instance, some jobs presuppose high-level education, and can therefore having such a job can be considered as a sufficient condition of high-level education. Some habits are indicators of education or lack of education, such as watching no TV or watching some TV programs. GRUNDY classified potential reader's personalities according to few and incomplete data, and then selected books appropriate to this kind of person. On the one hand, given the details specifying a person, a judge is classified as an educated person, according to the rule that "people doing qualified professional jobs are educated". On the other hand, a person who does not watch TV is classified as educated in virtue of the stereotype that "who watches no TV is educated". Even though the two cases are clearly different, they are both classifications based not on essential definitions, but on particular types of relations of equivalence. In those definitional propositions a category, namely "educated

person” is equated to a set of characteristics, which comprehend jobs and habits. The strength of the classifications depends on the relation between the factor and the class.

Case 3

The third case regards the definition of ‘life’. According to the NASA definition, life was defined as (Luisi 1998, p. 617):

> Life is a self-sustained chemical system capable of undergoing Darwinian evolution

This definition is grounded on two basic concepts: chemical system, and Darwinian evolution. These two notions can be clearly understood. However, how can an astronaut, in a limited amount of time, assess whether an observed entity is capable of undergoing Darwinian evolution? This problem was tackled by the biochemists in 1976 working on the Viking mission. The goal of this mission was to discover whether there were forms of life on the Mars. In order to classify the crystals found on the planet, a metabolic definition of life was adopted (Chyba, Phillips 2002, p. 58):

> an object with a definite boundary, continually exchanging some of its materials with its surroundings, but without altering its general properties, at least over some period of time

This definition was useful, given the conditions of lack of time and knowledge. The Viking biology team could not analyze the crystals for years, nor could they assess how much time would be required for a Martian entity to evolve. They could only make some experiments and observe some particular characteristics of the entity in a short length of time. The metabolic definition allowed the scientists to determine whether the entity was a form of life or not only on the basis of some observations.

Using this definition, some observation were made on a satellite of Jupiter, Europa. As some chemical changes associated with metabolism were observed, the provisional conclusion was that there was life on Europa (Klein 1978). However, even if this definition was extremely efficient given the conditions, it led only to provisional results. When new experiments were made on the samples from Europa, and the same data were analyzed differently, it was found that life could not exist on the satellite. The scientists had adopted a different definition, namely the following biochemical definition (Sagan 2007, p. 3):

> A biochemical or molecular biological definition sees living organisms as systems that contain reproducible hereditary information coded in nucleic acid molecules and that metabolize by controlling the rate of chemical reactions using proteinaceous catalysts known as enzymes.

As no organic molecule could be found either on the samples, or on the soil, life there (so defined) could not be possible, and the chemical changes observed were explained as the basis of the reasoning leading to that conclusion.

This example shows a conflict between a shared definition of life, and heuristic definitions adopted to classify entities. Quoting Chyba and Philliphs (2002, p. 58), "the Darwinian definition may be useful for interpreting laboratory experiments, or guiding

thinking about how ‘the origin of life’ on early Earth is to be conceived"; however, in a search for life it is useless. This case shows also how provisional the classifications based on heuristics are. The two adopted definitions, the metabolical and the biochemical, are grounded on signs. In the metabolical definition the effects of life were taken into consideration: as a living being exchanges materials with its surrounding, a living being is what exchanges material with its surrounding. The second definition is based on a different type of sign: as the different forms of life grow, reproduce, and evolve because of nucleic acid molecules, those molecules can be considered as causes of some characteristics of life.

3. Simplifying heuristic reasoning: patterns of reasoning and presumptions

Classifying entities on the basis of the semantic properties of words is often extremely difficult, and sometimes impossible, especially when little time is left to make such classificatory decision, or when no enough information is available. Moreover, the outcomes of the most “creative” patterns of human reasoning are highly uncertain, and depending on the variables, shared knowledge, and reasoning ability of the speaker the conclusion may be noticeably different. For instance we can consider the reasoning pattern in table 2 (from Walton 2002: 44):

Explanation under lack of knowledge	
▪ *F* is a finding or given set of facts. ▪ *E* is a satisfactory explanation of *F*. ▪ No alternative explanation *E'* is as satisfactory as *E*. ▪ Therefore, *E* is plausible, as a hypothesis.	▪ No smoke is observed ▪ There is no smoke ▪ The other possible explanations (the smoke cannot be seen because of the distance; the smoke has been covered...) are not as satisfactory as the absence of smoke. ▪ Therefore there is no smoke

Table 2: Explanation under Lack of Knowledge

Such pattern of reasoning is frequently used to classify entities or facts under lack of knowledge. For instance, a person can be considered as ‘dead’ (on one definition) when the electrical activity in his or her brain ceases. However, when the person is missing, such ‘deductive’ pattern of reasoning from definition cannot be applied. Instead, an explanation of his or her disappearance needs to be found, and his or her classification as ‘dead’ can be considered the best explanation.

Classification under lack of knowledge

PREMISE: If *A* were *X, Y, Z,* then *A* would be known to be *X, Y, Z.*
PREMISE: It is not the case that *A* is known to be *X, Y, Z*
PREMISE: A can be either *X, Y, Z,* or *K*. Other possibilities are not known.
CONCLUSION: Therefore *A* is *K.*

This type of reasoning is frequently used to account for symptoms or relate facts to causes. For instance, stomach-ache can be explained as a result of intoxication. however,

several other illnesses may have caused it. In law, the use of a deadly weapon to stab a victim can be explained as an intention to kill, but many other reasons may have induced the aggressor to use such instrument. This pattern of reasoning heavily relies upon the completeness of the information available, and on what is a 'good explanation'. Clear examples of the defeasibility of this pattern reasoning can be found in toxicological studies. From the absence of negative symptoms of a substance in a limited period of time it is frequently concluded that such substance has no negative effects on humans. However, the symptoms of some types of disease, such as cancer, may appear later on in life. Several 'best' explanations can be provided for a symptom or the absence of symptoms can be provided. Moreover, discussions about the reasons why one explanation is better than another might make the whole decision-making process too time-consuming to be useful.

Reasoning from analogy can be considered as a similar pattern used in heuristic reasoning to classify an entity in a condition of lack of knowledge. How is it possible to apply a rule to cases, when the only available information is a generic definition or some previous instances of classification? If we consider the argument from analogy, we can notice how much is left undetermined (Walton 1995: 135-136):

> MAJOR PREMISE: Generally, case C_1 is similar to case C_2
> MINOR PREMISE: Proposition A is true (false) in case C
> CONCLUSION: Proposition A is true (false) in case C_2

What does 'similar' mean? What does 'generally' refer to? Heuristic reasoning is provisional and defeasible, and its purpose is to provide a possible hypothesis, reversing the burden of providing further evidence or bearing out a different conclusion onto the other party; however, sometimes it needs to be ruled by shortcuts, which bypass 'creative' patterns of reasoning. One of the most common shortcuts to heuristic reasoning is presumption, that is, a postulate applied in advance to all cases of a particular type. For instance, the death of a person can be only a possible explanation of his or her disappearance. The presumption of death provides a provisional criterion of classification for determining in lack of knowledge whether a person can be considered to be dead (*Gardner v. Wilcox* 370 F.2d 492, 494 (9th Cir.1966)):

> It was there held that when the facts show that a person has been absent from his residence and unheard of for a period of seven years, a presumption arises that he is dead. The burden of explanation then shifts to the Secretary, and the presumption can be dissipated "by proof of facts that rationally explain the anomaly of the disappearance in a manner consistent with continued life."

Such principle lying beneath presumptions also applies to the classification of more abstract concepts. For instance, intentions or inner states can be supported only by reasoning from explanation; titles, in condition of lack of evidence, can be only understood by signs. Presumptions avoid heuristic reasoning and provide a classification rule whose purpose is to shift on a dialectical level the weakness of a provisional pattern of inference. Consider the following presumptions (Lawson 1855, p. 93; 420)

> A person who is shown to have done any act is presumed to have done it innocently and honestly, and not fraudulently, illegally or wickedly.
>
> And the possession of personal property raises a presumption of title in, and ownership of, the property by the possessor.

Presumptions, however, are not the only simplified strategies of classification. There are types of definition which conceal a more complex structure of reasoning than simply attributing a predicate to an entity based on its semantic features.

4. Heuristic definitions and strength of inferences from classification

The traditional concept of definition, conceived as a statement expressing the fundamental semantic features of a concept, represent only one type of definition. There are several kinds of definitions based on different reasoning patterns used to classify entities and facts. The relationship between *definiens* and *definiendum* represented in such definitions is different from the kind of semantic identity expressed by a traditional definition, of the kind that we can find on dictionaries. Several methods of classification conceal complex patterns of heuristic reasoning. Like presumptions, heuristic definitions and definitional patterns of reasoning are shortcuts to classifications, a sort of abstraction from heuristic reasoning (see Rigotti-Cigada 2004). The strength of the arguments grounded on them inevitably depends on the nature of the reasoning lying beneath them.

4.1. Abductive definitions

In section 2, different types of heuristic classification were set out. Patients are classified on the grounds of symptoms, readers on the grounds of their habits, living beings on the basis of their constituents or behaviours. All those types of heuristic classifications are based on definitions of some kind. A high-risk patient is a patient who shows some symptoms; an educated reader for the computer is a person who has certain habits; a form of life is for the scientists an entity showing some changes or constituted of some elements. All those definitions could be classified as "definitional" statements. Even if advanced as definitions, they actually are signs. The purported identity relation is actually a sufficient condition of a classification, as the *definiens* represents an effect or a part of the *definiendum*. The pattern of reasoning from which these arguments proceed can be represented as follows (Walton 2002, p.42):

MAJOR PREMISE: Generally, if this type of indicator is found in a given case, it means that the presence of such-and-such a property may be inferred. (If p then q)
MINOR PREMISE: This type of indicator has been found in this case. (p)
CONCLUSION: Such-and-such a type of event has occurred, or that the presence of such-and-such a property may be inferred, in this case. (therefore q)

This type of reasoning is grounded on the inference from a sign to a cause. However, in the cases analyzed above, the link between cause and effect, or rather event (or entity) and its sign, is set forth as a definition, which establishes a kind of identity between two events or entities. In the examples above, when we consider the goal and the structure of

reasoning, we notice that it proceeds from a definition to a classification. Therefore it would appear to be a deductive pattern of reasoning. However, if we analyze the definitions those classifications are based on, it can be shown that they are abductive patterns of reasoning in which the abstraction process has been 'crystallized' into a rule of inference (Tuzet 2003, pp. 41-42). Abduction was conceived by Pierce as an inference that goes from facts to their explanations, characterized by the logical form of an inference to the best explanation (Wirth 1998; Aliseda 2006). As seen in section 3 above, the abductive pattern of reasoning called reasoning from best explanation is frequently used in presumptions. Such presumptions can be conceived as heuristic definitions, that is norms regulating heuristic classifications, making abstraction from data to hypotheses explicit. In other words, abductive classification as used in law can be conceived as having the following structure (Tuzet 2003, p. 43):

> if the case S has the characters P1, P2, P3, and the legal concept M has such characters, the case S has the legal character M

This reasoning is clearly abductive; however, the passage from the case (or facts) and the classification (or explanation) can mediated by a rule, making the reasoning apparently deductive. Still, when carefully analyzed, the reasoning is shown to be abductive,

4.2. Causal definitions

Abductive reasoning is not the only type of argumentation presupposed by reasoning from classification based on heuristic definitions. A common type of heuristic classification in physics is represented by the use of operational definition in a manner that can be explained as follows (Bridgman 1927, p. 5):

> We may illustrate by considering the concept of length: what do we mean by the length of an object? We evidently know what we mean by length if we can tell what the length of any and every object is, and for the physicist nothing more is required. To find the length of an object, we have to perform certain physical operations. The concept of length is therefore fixed when the operations by which length is measured are fixed: that is, the concept of length involves as much as and nothing more than the set of operations by which length is determined

Concepts like length or weight can be essentially defined; however, those definitions are hardly useful when an entity has to be classified within a measure scale. A concept like "long" can be therefore defined through a correlation with a human activity (Rößler 1998, p. 68), like measurement (Rößler 1998, p. 25):

> lang $=_{def}$ /mit dem Meterstab messen/ (long $=_{def}$ /measure with a metre rule/)

The *definiendum* is defined through the activity and the instrument relating the concept defined (length) to a physical perception. Operational definitions are of fundamental importance for classifying an entity in conditions of lack of time, or knowledge (Thomas 2005, p. 575):

> On October 15, 1970, the West Gate Bridge in Melbourne, Australia collapsed, killing 35 construction workers. The subsequent enquiry found that the failure arose because engineers had specified the supply of a quantity of *flat steel plate*. The word *flat* in this context lacked an operational definition, so there was no test for accepting or rejecting a particular shipment or for controlling quality.

The classification through abstract concepts caused misunderstandings, which could have been avoided if the concept of "being flat" had been defined through a test, and not an abstract conceptual definition.

Operational definitions follow a pattern of reasoning from effect to cause. The measure is the result of an operation which is, in its turn, the effect of the phenomenon to be defined. This type of definition is a kind of contextual definition: it does not explain what a concept is, but what the concept amounts to in a specific place and time. The structure of reasoning underlying classification from operational definition is shown in table 3.

Pattern of reasoning	**Example**
MAJOR PREMISE: Generally, if *A* occurs, then *B* will (might) occur.	If the temperature is x, the electrical resistance of a thermistor calibrated against operationally defined fixed points will be x.
MINOR PREMISE: In this case, *B* occurs	The thermistor indicates 25 degrees Celsius
CONCLUSION: Therefore in this case, *A* will (might) occur.	Therefore the temperature is 25 Celsius

Table 3: Classification from Operational Definition

Thus argument from operational definition can be conceived as proceeding from a pattern of reasoning from effect to cause. This type of reasoning is different from abductive reasoning, as the definition does not represent a rule concealing heuristic reasoning, but simply a physical law. The definition itself is nothing more than a law, and the argument simply proceeds from the effect to cause. The strength of the inference depends on the type of law, and on the relation between the effect and the cause. In some cases, the result of a measure can be brought about by factors different from the *definiendum*, and the inference is an instance of plausible reasoning from effect to cause (see Godden and Walton 2005; Walton 2004). In other cases, the relation between cause and effect is mutual, and the inference proceeds deductively.

4.3. Analogical definitions

The third pattern of argument from heuristic classification is grounded on analogical reasoning. Analogical reasoning is a pattern of reasoning used to classify an entity based on relevant similarities with another case (see Russell 1989). Analogical reasoning is crucial both in law and computing, where entities or facts frequently need to be classified where definitional rules are inapplicable or lacking. Analogical reasoning is represented in case-based reasoning (CBR), namely an attempt to represent what suffices to make one case like or unlike another. Resorting to the creative or psychological aspects of analogy

are avoided by determining a set of factors which may determine the attribution of a predicate to an entity (Brüninghaus, Ashley 2003). A clear example can be provided by the concept of ‘trade secret’. The determination and the regulation of trade secrets is inherently case-based, because decisions are based on the grounds of previous cases. However, even though there is not a rule, or a definition, to establish what is to be considered to be a 'trade secret', some factors can be abstracted from past cases and established as criteria to determine future classifications. Following the CBR model, an entity is classified as trade secret if the following factors are met (Restatement (First) or Torts, Section 757 comment b; see also Ashley 1991, p. 757):

1) the extent to which the information is known outside of his business;
2) the extent to which it is known by employees and others involved in his business;
3) the extent of measures taken by him to guard the secrecy of the information;
4) the value of the information to him and to his competitors;
5) the amount of effort or money expended by him in developing the information;
6) the ease or difficulty with which the information could be properly acquired or duplicated by others

Factors cannot be individually considered as necessary or sufficient conditions for a classification. Even if one or more factors are attributed to the entity, the classification may be not the case. On the other hand, even if one or more factors cannot be attributed to the entity, the latter may fall within the classification. Factors are criteria carrying presumption of a classification, but cannot be considered as conclusive proofs. They “designate collections of facts, commonly observed in cases, that tend to strengthen or weaken a plaintiffs argument in favor of a conclusion, such as a legal conclusion that the plaintiff has a trade secret” (Ashely 1991, p. 757).

Reasoning with factors represents a way of evaluating arguments from analogy. By providing a set of factors to determine the relevant resemblances between cases or instances, an analogical definition is set out. Past analogies are used to establish the characteristics of a new category, and these factors are used to avoid the use of the heuristic classification in other cases. Factors, like analogies, do not explicitly state the reason lying beneath a decision or classification, and their force depends on previous analogies. In the theory of case-based reasoning, analogy is modeled in terms of factors involved in both the compared entities, that is the source and the target of analogy (see Vosniadou-Ortony 1989, p. 414). The source and the target can present different types of factors, or characteristics. Some of them can be identical, and therefore favor the classification of the target under the same category of the source. Others can be different, and counter this classification. Reasoning from factors could be represented with the following pattern (for case-based reasoning, see Ashley 1991, p. 758; 2006; see Guarini 2004, p. 161 and Waller, 2001, pp. 201-202 for a similar treatment of analogy)):

T presents factors $f_1, f_2, \ldots f_n$	In the precedent, a prior court resolved the competing factors in favor of a particular side;
If *T* presents factors $f_1, f_2, \ldots f_n$, then *T* can be classified as similar to S	The current situation is analogous to the precedent because it involves the same competing factors;
T can be classified as similar to S	Therefore, the current dispute should be resolved in the same way.

Table 4: Scheme for Argument from Analogy Using Factors

This type of reasoning is actually a type of argument from classification, in which factors can be conceived as providing a precising definition representing an analogical reasoning. The new category under which the two analogous cases fall is not stated, but taken for granted, just like in analogies. The category defined is "to be similar to *x*".

As mentioned above, the non-deductive deep structure of argument assumes in such definitional patterns based on factors a deductive form. However, the difference in logical structure is shifted onto the difference in strength of the classification. While "deductive" definitions of the kind usually found in law or in dictionaries provide a fixed criterion of classification, "analogical" definitions only provide a provisional classification, where the category itself is not explicit or known, but left implicit. This concept clearly emerges when we consider cases of analogical reasoning in law. For instance, in *Vanderpool vs. The Steamboat Crystal Palace*, p. 494[4], the liability of steamboats operators from the point of view of security measures and passengers expectations was to be determined. Therefore, steamboats operators were compared to innkeepers, as the relevant factor "to be so furnished as to offer the passenger the protection of lock and key" was considered. This factor made operators of steamboats differ in no essential respect from innkeepers, and therefore they could be classified under this category. This argument is not simply based on a set of shared factors, but on a relation between the factor and the classification. The strength of the reasoning crucially depends on a new category set up by the comparison. For instance, the new category of "structures with protected compartments for clients' accommodation" was abstracted from the concept of "inn" and used to classify new case. Factors do not account for or support the creation of a new category; they simply provide criteria to establish a similarity. The strength of such similarity depends on what is relevant for the purpose of the reasoning.

4.4. Inductive definitions

The last type of heuristic reasoning from classification is based on generalization. As mentioned in case 2 in section 2, generalizations are frequently used as criteria of classification, and are commonly associated with stereotypes. However, while inductions proceed from quantitative analyses to a generalization, stereotypes can be considered as rules of classification based on past experiences. Stereotypes are the result of an induction and play the role of definitional propositions. For instance, the stereotype that a person who watches no television is educated is grounded on past experience of educated people who did not watch television. However, when used to classify entities in the category of "educated people", this generalization becomes a rule of classification whose strength depends on the presupposed inductive reasoning.

Inductive reasoning often is a weak line of argument supporting a conclusion (see Uviller 1996, p. 218; Walton 2006, p. 13). However it is often is greatly impressive to a jury. A clear case in which generalization played a crucial role is *R v Sally Clark*, EWCA Crim 1020 (2003). In this case a British solicitor, Sally Clark, was wrongly convicted of the

[4] See also Carriers and Innkeepers Act 1958 - SECT 28: "Subject to this Act, the keeper of an inn shall be under the same liability to make good damage to property brought to the inn by or on behalf of a traveller using its facilities as is imposed on him by law with respect to the loss thereof".

murder of two of her sons, both died within few weeks of their birth. The prosecution's argument relied upon medical proofs, but one argument was very persuasive.

> The prosecution also relied on statistics given by Professor Meadow and drawn from a draft report by the Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI), in particular that the probability of two SIDS deaths in one family matching the profile of the appellant were 1 in 73 million

This heuristic argument proved to be logically weak. However, it was one of the most powerfully persuasive claims supporting the decision. Generalization are often used in classification, but they more commonly assume the form of stereotypes (Amossy - Herschberg-Perrot 1997; Amossy 2000).

A clear example of classification by stereotypes can be found in *Frontiero v. Richardson*, 411 U.S. 677 (1973). In this case, the Supreme Court ruled on a case turning on an example of classification by gender stereotypes. Sharron Frontiero, a servicewoman in the United States Air Force, applied for benefits for her husband whom she claimed as a 'dependent'. However, while the men serving under the Army need not prove that their wives were dependent on them, servicewomen had to provide evidence to support their claim (411 U.S. 677, 679). Such rule was grounded on a stereotype, namely that since the husband in our society is generally the bread-winner in the family,and the wife typically the dependent partner".

5. Heuristic classifications and reasoning from classification

Strategies of heuristic classification are also represented by some types of definition, or rather, definitional propositions. Some types of definitions are not convertible with their *definiendum*, and their purpose is to make a classification plausible. In contrast with genus-species definitions, which play the role the of the major premises in a rhetorical syllogism (see Macagno and Walton 2008), definitions by parts or accidental properties cannot be the grounds for deductive types of reasoning. Such definitions can be conceived as a different way of presenting the same processes of reasoning. Even though definitions are rules of classification which can be used in deductive patterns of reasoning through the application of deductive axioms, they are different in nature. Some arguments based on definition are extremely powerful, while others carry only some weight in support of the conclusion. This difference can be found in their structure, and in the logical-semantic relation between the *definiens* and the *definiendum*. Depending on the nature of this relation, the argument will greatly differ. When the definition is not essential, it can be the result of heuristic reasoning transformed into a rule of classification.

As hypothesized by Evans (2008b), the human mind is characterized by two systems of reasoning. An associative, heuristic reasoning (system 1) is contrasted with a rule-based reasoning (system 2) (see Evans 2008a, p. 261; Kahneman & Frederick 2005). Heuristic judgments carry only presumptive weight in support of the conclusion, whereas deductive reasoning is conclusive (conditional on the truth of the premises). Also, we need to notice how rule-based judgements depend on the nature and acceptability of the rule itself. In some rules the relation between antecedent and consequent is univocal, in others mutual. In some rules the consequent expresses the sufficient condition of the

antecedent, in others the antecedent does not express a sufficient condition, but only a necessary criterion for classification. Reconstructing the process of reasoning underlying a rule of classification allows one to analyze the type of reasoning from classification actually supported by the definition. The semantic structure of the definition and the logical form of arguments from classification are strictly interwoven. Instead of simply examining reasoning from classification as a deductive *modus ponens* type of reasoning, we have analyzed the various forms of defeasible argumentation we have studied as instances of DMP. Our main conclusion is that since the rules of inference supporting arguments to and from definitions and classifications are best seen as defeasible in nature, the arguments themselves are best treated as defeasible.
The dependence of the logical form on the nature of the definition it is grounded on can be represented in the summary in figure 2 contrasting the superficial and deep structure of argumentation based on classification and definition.

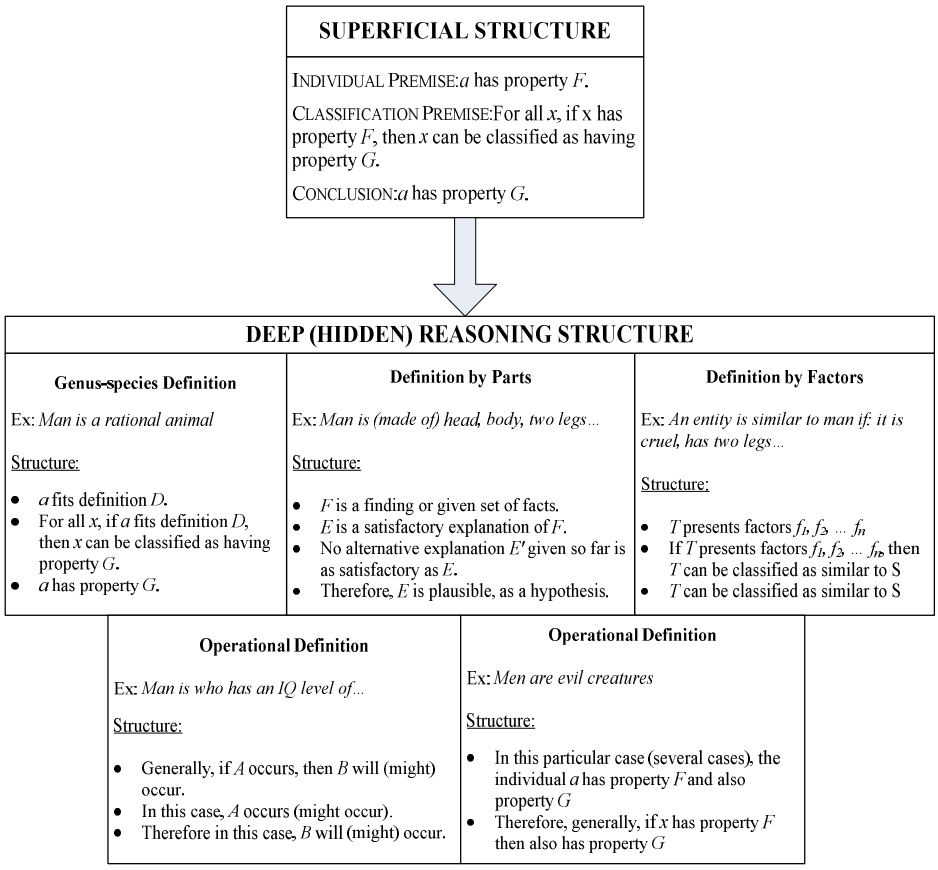

Figure 2: Superficial and Deep Structure of Arguments from Classification

The heuristic processes of classification, which we labelled as definitional, as they advance a possible equivalence between a concept and its description, are in the above model connected to the underlying pattern of reasoning. While definitional statements trigger patterns of inference that are apparently deductive, in fact they conceal weaker forms of reasoning. The conclusion in such cases is only presumptive, shifting the burden

of providing a better classification or missing evidence onto the other party, and needs to be evaluated based on the heuristic type of reasoning of which it represents a shortcut.

6. Conclusion

Reasoning from classification can be described as the reasoning supporting the attribution of a predicate to an entity. Traditionally the gap between a noun and its predication has been bridged using the notion of definition. The crucial issue is to determine what a definition is. In the tradition, definitions were regarded as statements expressing the meaning of a term, or setting forth an equivalence between the *definitum* and the *definiens*. However, if we analyze real world examples, we can notice how definitions by genus and difference, or definitions explaining the fundamental semantic features of a concept, are of no use when an object or event needs to be classified. Semantic characteristics can distinguish a concept from another within a semantic system, but tell us little about how to name reality. Definitional statements, expressing an often imperfect correspondence between the two members of a definition, provide a useful instrument to categorize entities in conditions of incomplete knowledge. Considering heuristic classifications, we noticed how the patterns of reasoning used in lack of knowledge are not based on rules, but abstract a possible, provisional rule on the basis of previous cases, signs possible explanations or similarities. Such patterns of reasoning are, however, complex, and are frequently simplified by presumptions, or provisional rules of inference or classification under conditions of lack of evidence. Extending the legal paradigm, we showed how presumptive rules of classification are used to avoid more complex processes of reasoning. They do this by supporting a conclusion that is only provisional and whose dialectical purpose is to fulfil the burden of classifying an entity, leaving to the other party the onus of providing further evidence or advancing a stronger pattern of reasoning. We showed that the different patterns of reasoning from classification we found are all grounded on definitional statements used as presumptions that skip creative reasoning steps.

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