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Analogical Arguments: Inferential Structures and Defeasibility Conditions

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Abstract The purpose of this paper is to analyze the structure and the defeasibility conditions of argument from analogy, addressing the issues of determining the nature of the comparison underlying the analogy and the types of inferences justifying the conclusion. In the dialectical tradition, different forms of similarity were distinguished and related to the possible inferences that can be drawn from them. The kinds of similarity can be divided into four categories, depending on whether they represent fundamental semantic features of the terms of the comparison (essential similarities) or non-semantic ones, indicating possible characteristics of the referents (accidental similarities). Such distinct types of similarity characterize different kinds of analogical arguments, all based on a similar general structure, in which a common genus (or rather a generic feature) is abstracted. Depending on the nature of the abstracted common feature, different rules of inference will apply, guaranteeing the attribution of the analogical predicate to the genus and to the primary subject. This analysis of similarity and the relationship thereof with the rules of inference allows a deeper investigation of the defeasibility conditions.

Keywords Analogy · Argumentation schemes · Argumentation · Rhetoric · Defeasibility · Inferences · Interpretation

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1 Introduction: Analogical Arguments and Their Assessment

Analogical reasoning is a complex process based on a comparison between two or two pairs of entities or states of affairs (the Analogue and the Target) sharing some common features (Bartha 2010, p. 1). This comparison is the ground of a specific type of inference (the so-called argument from analogy), in which the conclusion consists in the attribution of a specific feature (a quality; a predicate) characterizing the Analogue to the Target (also called Primary Subject) (Copi and Cohen 2005; Davies 1988; Guarini et al. 2009; Macagno and Walton 2009; Walton 2010, 2014). The most generic structure of this pattern of reasoning can be represented as follows (Walton et al. 2008, p. 56):

Major Premise	Generally, case <i>C1</i> is similar to case <i>C2</i>
Minor Premise	Proposition <i>A</i> is true (false) in case <i>C1</i>
Conclusion	Proposition <i>A</i> is true (false) in case <i>C2</i>

This generic pattern can be explained by distinguishing its components. The similarity is regarded as holding between two cases, namely two distinct circumstances instantiating the variables of Proposition *A* (the subject or predicates attributed to it). Such cases are framed within a context, which includes the certainties and the rules that are believed to hold (Meheus 2000, p. 27).

A fundamental problem in logic, law, and philosophy of science is how to assess analogical arguments, which amounts to how to describe the analogical inference and the similarity relation on which it is based (Ashley and Rissland 2003; Ashley 2006; Waller 2001; Weinreb 2005). The critical questions cited in (Walton et al. 2008, p. 62), point out some fundamental dimensions of defeasibility:

- CQ₁ Is *A* true (false) in *C1*?
- CQ₂ Are *C1* and *C2* similar, in the respects cited?
- CQ₃ Are there important differences (dissimilarities) between *C1* and *C2*?
- CQ₄ Is there some other case *C3* that is also similar to *C1* except that *A* is false (true) in *C3*?

The defeasibility aspects mentioned, however, do not address two basic problems: (1) determining what is an important similarity/dissimilarity for the purpose of the inference; and (2) defining and assessing the respects under which the two terms are considered as similar. The argumentation scheme and the critical questions do not involve, in other words, the nature of the common features on which the comparison is grounded, and the nature of the inferences supporting the analogical conclusion.

The starting point for addressing these problems can be found in the concept of relevance that constitutes one of the acknowledged grounds of analogical reasoning. In the literature on analogical arguments, one of the requirements that the shared features of the terms of the comparison need to meet is “to be relevant” to the attribution of the property (Copi and Burgess-Jackson 1992, p. 1992; Hesse 1966; Russell 1988; Waller 2001, pp. 201–202; Weinreb 2005, p. 32). For this reason, the comparison is not between the shared features per se, but rather “between the causal

or higher-order relationships in which the items in an analogy participate” (Shelley 2003, p. 6). On this view, analogies can be thought of as abstractions, or rather as identities at an abstract level (Darden 1982, pp. 151–152). A “super-ordinate category” (Glucksberg and Keysar 1990) is thus created, which includes the terms of the analogy for the purpose of guaranteeing the attribution of the relevant property. In order to analyze the strength and defeasibility conditions of analogical arguments, it is necessary to investigate the nature of such an “abstract category,” and more specifically the kind of features drawn from the terms of the analogy. Such characteristics can be semantic (fundamental or peripheral), commonly shared (common knowledge), or merely abstracted from a state of affairs. These distinctions are crucial for understanding the nature and the force of an analogical conclusion.

The purpose of this paper is to develop the structure of analogical arguments from an argumentative point of view, addressing the aforementioned problems by investigating two interrelated issues. On the one hand, we will analyze the mechanism of abstraction, distinguishing among various types of comparisons that can be the ground of different types of analogical arguments. We will then investigate the possible rules of inference that can guarantee the passage from the comparison to the predication of the relevant property to the Target. On this perspective, analogical arguments can be regarded as based on different types of reasoning, sharing a common general structure, an abstraction that can be considered as a functional, non-essential genus. Analogy can be thus thought of as a type of redefinition (Macagno 2014) developed and used for the purpose of supporting the attribution of a property to an entity or a state of affairs.

The theoretical framework that we will use is based on an interpretation of the treatment of analogy and rules of inference advanced in the classical dialectical tradition stemming from Aristotle’s *Topics*. The ancient topics will be considered as rules of (semantic) inference (Bird 1960, 1962; Macagno et al. 2014) characterizing the so-called predicables, or the possible classes of all predications (Malink 2013, p. 116). We will show how this logical and semantic framework can be applied to the analysis of the inferential steps that characterize the various types of analogical arguments, bringing to light the relationship between their pragmatic, semantic, and logical dimensions.

2 Topics as Rules of Inference

Arguments from analogy can be described as defeasible patterns of argument (Macagno and Walton 2006; Walton et al. 2008), namely a set of premises supporting a conclusion and assessed through critical questions. In most of the argument patterns, the reason (or rather the premise) warranting the conclusion based on a specific description of a state of affairs is explicit. In other cases, such as in the pattern of argument of analogy set out above, it is implicit. This implicit or explicit generic and warranting premise can be regarded as the modern equivalent of the ancient topics, or the *maxima propositio* in the Latin and medieval dialectical tradition (Slomkowski 1997, pp. 53–56). For example, the previously mentioned scheme is grounded on an implicit general premise stating that “Regarding similar,

the judgment is one and the same” (*De Topicis Differentiis*, 1197B 27–28). However, in the modern tradition of argumentation theory (Cummings 2015, pp. 93–120; Juthe 2005; Ribeiro 2014; Walton 2010), the issues concerning what makes two states of affairs or entities “similar,” and why and how the judgment (the attribution of a specific property) shall be “one and the same” are still to be analyzed in depth. A possible answer can be found by investigating the ancient concept of *topoi*, and using them to bring to light the reasoning steps underlying the argument from analogy. In order to do so, it is necessary to explain first how topics can be interpreted from an argumentative perspective, and how they are involved in arguments grounded on comparisons and similarities. In this section we will address the first issue, while in the following sections we will apply the rules of inference set out in the topics to the various types of arguments from analogy that will be distinguished.

The nature of Aristotle’s *topoi* was a central issue of inquiry in the Middle Ages and remains so in modern and contemporary studies on natural inferences (de Pater 1965; Kienpointner 1997, 2001; Stump 1982). One of the crucial debates concerned their function (Rubinelli 2009), in particular whether they were instruments for finding arguments or rules on which dialectical and rhetorical inferences were based (Rubinelli 2009, p. 13; Slomkowski 1997, p. 54; Stump 1989, p. 22). The interpretation of the Aristotelian *topoi*, or at least some of them, as rules of inference (Bird 1960, 1962; Christensen 1988; Drehe 2011; Stump 2004), is of fundamental importance for the analysis of natural inferences and argumentation studies in general (Drehe 2011; Rigotti 2007; Toulmin 1958).

The rules of inference described in the *Topics* can be investigated in relationship to their role in defeasible arguments. In this sense, they can be regarded and used as the premises of defeasible argument patterns (Drehe 2011; Macagno et al. 2014; Rubinelli 2009), grounded on semantic principles. Inferences linking statements such as “This pen is red; therefore it is colored” cannot be considered as purely logical, in the sense of being purely formalized according to the semantic system used in modern formal logic. Such inferences can be analyzed from a material point of view, relying on relations between the terms that are more complex than the number, arrangement of the terms, and the syntactic connectors (Green-Pedersen 1987, p. 413). Rather, these arguments need to be analyzed from their material side, taking into account the “nature of the things which the terms of the argument represent or stand for” (Green-Pedersen 1987, p. 413). The topics confirm the arguments based on relations between universal concepts (such as genus, species, etc.) under which the terms of an argument are subsumed. This material relationship between the terms and the universal concepts was called *habitus* in the ancient dialectical theory (Abaelardus, *Dialectica*, pp. 263–264). The *habitus* is the topical relation, the semantic-ontological respect under which the terms are connected to each other in a (dialectical) syllogism (Green-Pedersen 1984, p. 185; 1987, p. 415), and on which the strength of the inference depends (Abaelardus (1970), *Dialectica*, p. 254). In the example above, the passage from the quality “to be red” attributed to the subject to the different quality “to be colored” is grounded on a relation of semantic inclusion between these two predicates, i.e. a genus-species relation (Bird 1962). This relationship guarantees the inference based on a rule (the maxim) that

Table 1 Rules of inference and the material structure of arguments

Consequence	If Socrates is a man, he is an animate being
Maxim	What the species is said of, the genus is said of as well
Assumption	But “man,” which is the species of “animate being” is said of Socrates; also therefore “animate being”, which is clearly its genus
Assumption 1	“Man” is a species of “animate being”
Syllogism 1	What the species is said of, the genus is said of as well Man is species of “animate being” Therefore, if “man” is said of anything, “animate being” is said of it as well
Syllogism 2	If “man” is said of anything, “animate being” is said of it as well Socrates is a man Therefore Socrates is an animate being

expresses a necessary consequence of the concept of genus itself. The genus expresses the generic fundamental features of a concept, answering to the question “what is it?” and is attributed to all the concepts different in kind (Aristotle, *Topics*, 102a 31–32). For this reason, it is predicated of what the species is predicated of. This rule follows directly from the type of semantic-ontological relation between the terms (Stump 1989, p. 36) and can be represented as in Table 1:

The material relations, or better the “material” form (Green-Pedersen 1987, p. 414) of arguments can be used to investigate the common structure of the different types of analogical arguments (Lloyd 1966), and distinguish the various types of inferential passages characterizing them. The first step to pursue this goal is to acknowledge the existence of various types of arguments from analogy, characterized by distinct types of comparisons, or rather distinct forms of “similarity.”

3 Likeness and Similarity

As mentioned above, analogy is commonly defined as grounded on a comparison, which in turn presupposes a similarity between the analogue and the target. One of the crucial problems in the literature on analogical arguments (and analogical reasoning) is how to analyze the relationship between similarity and analogy, namely which features need to be shared in order to warrant the inference, and why. In the modern literature on analogy, the notion of relevance is considered to be pivotal for understanding why some shared features are related to the analogical conclusion (Hesse 1966; Russell 1988, pp. 251–252). However, in order to analyze and assess the strength of the different types of analogical arguments, it can be useful to distinguish between the different ways in which the terms of a comparison can be similar (Gentner 1980, p. 5). To this purpose, the Aristotelian account of similarity and likeness can provide some useful insights that can be used to investigate the possible “material” inferences that can be drawn from a comparison.

As Lloyd (1966) observes, the study of likenesses was important to Aristotle's logical system: it is one of the means by which we are well supplied with syllogisms and inductions (Aristotle, *Topics*, 105a21ff). In fact, the logical structure of *analogia* (analogy), or rational correspondence, was developed by Aristotle in the *Topics* in close connection with the notion of likeness (*homoiotês*) and the maxims related thereto (Bartha 2010, p. 36). Cicero treated similarity as the ground of two distinct and interconnected types of argument that were later distinguished in the medieval dialectical tradition, i.e. the *locus*¹ (or rule) from similarity and the *locus* from proportion (Boethius *De Topicis Differentiis*, 1190A 35–1190D6; 1190D30–40). Aristotle pointed out that a likeness can be of two types, or rather can have as its object two distinct types of concepts, the ones belonging to different genera and the ones belonging to the same one (Aristotle, *Topics*, 108a7–108a17):

Likeness should be studied, first, in the case of things belonging to different genera, the formula being: as one is to one thing, so is another to another (e.g. as knowledge stands to the object of knowledge, so is perception related to the object of perception), or: as one is in one thing, so is another in another (e.g. as sight is in the eye, so is intellect in the soul, and as is a calm in the sea, so is windlessness in the air). [...] We should also look at things which belong to the same genus, to see if any identical attribute belongs to them all, e.g. to a man and a horse and a dog; for in so far as they have any identical attribute, in so far they are alike.

Likeness concerns both concepts involved in distinct generic semantic properties and concepts sharing the same “essential” genus. In the first case (that we will refer to as “likeness 1”), the comparison is between two relations, and likeness is regarded as an identity of relations (as *A* is to *B*, so is *C* to *D*). In the second case (that we will refer to as “likeness 2”), the terms of the comparison share the same generic fundamental characteristics, and are subject to the same predications (*hyparchein*). This latter type of similarity can be the basis of a different type of reasoning, aimed at attributing a predicate *P* to a Target *A* based on its essential (definitional) similarity with the Analogue *B*.

From an argumentative point of view (Macagno and Walton 2014; Rigotti 2007; Rubinelli 2009), the Aristotelian dialectical treatment of likeness can be regarded as based on concepts and essential (or rather semantic, definitional) relations between them. On this interpretation, the subject matter of the comparison is a relation of predication, namely it takes into consideration how a predicate is attributed to a subject (Green-Pedersen 1987). Both types of likeness described here are aimed at supporting a predication based on a similar logic-semantic relation. In the first case, the similarity is between the kinds of predication compared, while in the second case the attribution of the Predicate to the Target is supported by a relation between two semantic features, i.e. such a predicate and the semantic genus of the terms of the comparison.

The description of likeness as an analysis of the semantic (likeness 2) or logic-semantic (likeness 1) characteristic of concepts was developed in the medieval

¹ This is the Latin term that corresponds to *topos* in the Greek.

tradition by investigating another type of similarity concerning not the properties of concepts but rather the characteristics of classes of particular states of affairs or entities. The Aristotelian likeness of concepts belonging to different genera was distinguished from the idea of proportion, an accidental identity between two relations. As Boethius put it (Boethius, *De Topicis Differentiis*, 1191B 30-34):

Suppose there is a question whether the rulers of cities should be chosen by lot. We might say: not at all, because not even a pilot of ships is appointed by lot, for there is a proportion here. A pilot is related to a ship as a ruler to a city.

In order to distinguish the difference between this type of similarity and likeness 2, we need to analyse the concept of proximate genus, interpreting it in a pragmatic sense. Clearly, horses, dogs, and men are much more dissimilar (share far fewer semantic features) than rulers and pilots. However, for the purpose of the predication, rules and pilots need to fall under the most specific concept that is common to both and can justify the predication of “being chosen by lot.” The most specific semantic feature that horses, men, and dogs have in common (in this case generally speaking, without any specific dimension to be taken into account for the purpose of a predication) happens to correspond to a fundamental definitional trait, namely “being an animate, mammal being.”

While rulers (persons ruling a country) and pilots (persons steering a ship) are both “human beings,” this common generic feature is not proximate enough for the purpose of justifying the comparison (why pilots and not chairmen?). In this sense, the justification of the comparison needs to be found in the respect under which they are regarded for the purposes of being chosen according to a specific criterion. The common feature that can provide this justification characterizes a proximate “quasi” genus that is, however, not semantic (or definitional) (Lloyd 1962). For the purpose of this predication, they can be regarded as falling under a non-definitional category, namely the “genus” of persons performing an activity involving a responsibility towards other people *in virtue of specific skill or expertise*. This abstract category is only metaphorically a genus, as it is non-essential (an unskilled pilot or ruler is still a pilot or a ruler) and necessary only for the purpose of the comparison (a ruler could be compared to a chairman, but the most proximate category under which they could fall would not be characterized by skill or expertise). It has no name (Lloyd 1962), in the sense that it is not a definitional (or inherent) component. As Petrus Hispanus pointed out (*Summulae Logicales*, V 34):

[The Topic from Proportion] differs from the Topic from the Like because in the latter, comparison is based on an inherent likeness, as in ‘as risibility is in a man, whinnibility is in a horse’; but in the Topic from Proportion, a comparable relation rather than inherent likeness is attended to, for example: ‘a sailor is to his ship, as a teacher is to his classes’.

Petrus Hispanus emphasized how likeness is related to essential, i.e. semantic, properties of the concepts (Walton and Macagno 2009). “To whinny” can be attributed only to horses, and the Latin verb “*rideo*” (to laugh) was predicable only of human beings in its proper meaning. The purpose of “proportion” is not to point

out an identity that is at the level of concepts and their fundamental components, but rather an accidental and relational one (Gentner 1980, p. 9).

The fourth and last type of similarity is not between concepts but between individuals, i.e. the *denotata*, the particular things referred to by predicates (in the logical sense) (Levin 1982). Two specific instances of a state of affairs are regarded as similar from a specific respect, and from this comparison a more generic predication is abstracted, which is then attributed to all cases characterized by such a common feature. This type of similarity is different from the proportional one. In the latter, the terms of the comparison are concepts, not specific instances, and, therefore, the similarities have an ontological, semantic ground (Levin 1982), namely they are drawn from shared beliefs (*endoxa*) concerning how things are in general or should be. By contrast, in a similarity between individual states of affairs the common property is not already accepted and shared, but discovered through the comparison. In this sense, it is “empirical” (Levin 1982). This type of similarity is the ground of a type of reasoning, the “example,” that has been regarded in the Aristotelian and medieval tradition as a kind of “rhetorical induction.” Petrus Hispanus pointed out the relationship between example and likeness as follows (*Summulae Logicales*, V 3):

The form of argumentation called example is when through one particular, another particular is tested because of some likeness found in the pair, for example:

“It is bad for Leonese to fight Astorgans; therefore it is bad for Astorgans to fight Zamorans.”

Similarity is the ground of this type of reasoning, proposing, instead of illustrating, a generic accidental abstract category (war against neighbours) under which the different instances fall (Levin 1982) and in virtue of which the predication (to be detrimental to the attacker) is justifiable (a possible and unstated relation of cause-effect) (Hesse 1988). We can represent the distinct types of similarity in Fig. 1:

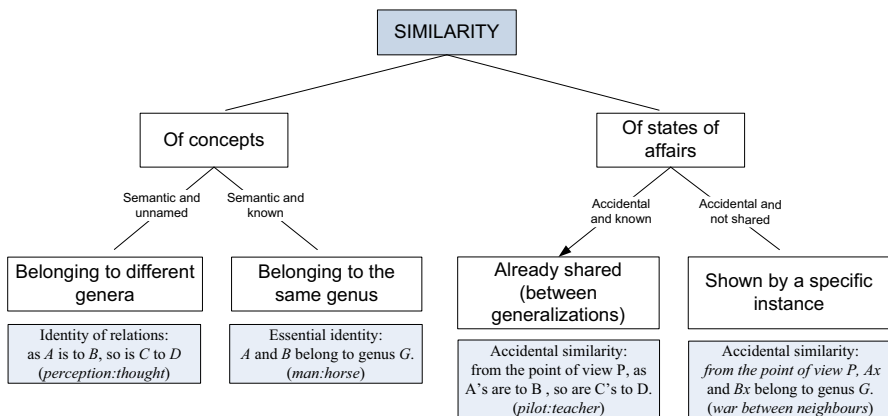


Fig. 1 Types of similarity

These types of similarity (the two types of likeness; proportion; and example) can be considered as the grounds of distinct and similar types of reasoning that the tradition has analysed as distinct forms of analogical reasoning. Such distinctions can be used to differentiate between the different types of analogical arguments, and provide criteria for assessing them. In order to investigate the logical mechanism common to the various types of analogies, it is necessary to bring to light the relation between reasoning and similarity, and how similarity can justify an inference.

4 Similarity as Abstraction

Similarity, as noted above, consists in identifying a characteristic common to distinct entities or states of affairs. The distinction between essential and accidental similarities brings to light the respect under which the common features are investigated, whether it concerns the semantic meaning of the concepts or a specific accidental point of view. From a logical-semantic point of view, this process of discovering a common semantic or accidental feature can be conceived as a process of abstraction (Darden 1982; Genesereth 1980; Gentner 1980; Kakuta et al. 1997), resulting in the identification of a generic, functional predicate that can be attributed to different entities different in kind (Macagno and Walton 2009).

In the *Posterior Analytics*, Aristotle pointed out that analogy could be used for identifying a characteristic common to various entities different in genus (see also Hesse 1966, Chap. 4), and for which no name exists (Aristotle, *Posterior Analytics*, 98a20-23):

Again, another way is excerpting in virtue of analogy; for you cannot get one identical thing which pounce and spine and bone should be called; but there will be things that follow them too, as though there were some single nature of this sort.

The pounce (of a cuttlefish), the spine (of a fish), and the bone (of an animal) do not belong to the same genus, but they can be conceived as the same analogically because they share the same semantic-ontological trait, “osseous nature.” As Aristotle points out in the *Metaphysics*, analogy presupposes a difference in genus of the concepts that can be considered as the same from a relational point of view (Aristotle, *Metaphysics*, 1016b31-1017a2):

Again, some things are one in number, others in species, others in genus, others by analogy; in number those whose matter is one, in species those whose formula is one, in genus those to which the same figure of predication applies, by analogy those which are related as a third thing is to a fourth. The latter kinds of unity are always found when the former are, e.g. things that are one in number are one in species, while things that are one in species are not all one in number; but things that are one in species are all one in genus, while things that are so in genus are not all one in species but are all one by analogy; while things that are one by analogy are not all one in genus.

The spine, the bone, and the pounce do not belong to a known common genus, but they can be thought of as having the same function considering their relation with the body of the various types of beings. They can fall under the category (Glucksberg and Keysar 1990; Hesse 1965, p. 329; 1966) of “osseous nature” (Aristotle, *Posterior Analytics*, 74a8), which is not part of the accepted definition of the concepts and has no name (in Greek at least) (Ross 1981). In this sense, this category cannot be called a genus in the Aristotelian meaning of the term. However, it is a predicate attributed to the target and the analogue indicating what they are for the purpose of the predication (the attribution of the relevant property). For this reason, this abstract category can be thought of a functional “genus,” taking the latter term metaphorically.

This treatment of similarity applies also to accidental similarities. A sailor and a teacher are essentially different, as their definitions are different, but they are the same from a specific point of view (see Cajetanus, *De nominum analogia*, c. IV, 36). This generic “concept” is abstracted based on the specific relationship between the two terms of the comparison (Levin 1982), namely the viewpoint that constitutes the purpose thereof. It does not correspond to the “essential” (or absolute, context-free) meaning (definition) (*De nominum analogia*, c. V, 49–50), but rather to a pragmatic, functional genus, setting out what the target and the analogous are for in the specific context. In this respect, essential and accidental similarities can be thought of as characterized by a similar process of abstraction. This step is crucial for understanding the ground of the inferences that are presupposed by analogical arguments.

5 Reasoning from a Common Semantic Genus

In spite of their common source in the process of abstraction, the aforementioned distinctions between types of similarity mark a basic divide between inferences from essential (i.e. intensional) likeness and the ones based on the concurrence of accidental features in two distinct states of affairs. The first type of inferences, treated by Aristotle in his dialectical work, can even shed light on the mechanisms underlying reasoning from accidental similarity, analysed in the *Rhetoric*.

As mentioned in the sections above, the relations of likeness (semantic similarity) constitute a genus that may be already known or that can be unexpressed, unknown, or unnamed. The discovery or the abstraction of a common genus is at the basis of the same type of reasoning, based on the topics that Aristotle provided in the most generic form as follows (Aristotle, *Topics*, 114b 29–32):

Again, look at things which are like the subject in question, and see if they are in like case; e.g. if one branch of knowledge has more than one object, so also will one opinion; and if to possess sight is to see, then also to possess hearing will be to hear. Likewise also in the case of other things, both those which are and those which are held to be like. The rule in question is useful for both purposes; for if it is as stated in the case of some one like thing, it is so with the other like things as well, whereas if it is not so in the case of some one of

them, neither is it so in the case of the others. Look and see also whether the cases are alike as regards a single thing and a number of things; for sometimes there is a discrepancy. Thus, if to know a thing is to think of it, then also to know many things is to be thinking of many things; whereas this is not true; for it is possible to know many things but not to be thinking of them. If, then, the latter is not true, neither was the former that dealt with a single thing, viz. that to know a thing is to think of it.

These principles of inference were developed in the medieval tradition, and led to the generic locus from like that is characterized by the following maxims (Petrus Hispanus, *Summulae Logicales*, V 33):

if one of the likes is present, the other is present as well.
if one of the likes is absent, the other is absent as well.

The generic maxims, provided by Aristotle in the second book of the *Topics*, were then made more specific in the following books of the same work, adapting them to two types of logic-semantic connections, the predicables genus and property (Aristotle, *Topics* 124a15).

The most basic type of reasoning from likeness is based on the type of essential and known similarity, i.e. the one that we indicated as likeness 1. The two likes are known to belong to the same genus, and inasmuch as a predicate is attributed to an analogue, it is also attributed to the Target. For instance, a man and a dog are animals, and since dogs breathe (or have instincts), men will breathe (or have instincts) as well. However, this type of reasoning holds only in the case of specific predicates: it is reasonable to conclude that men breathe because dogs do also, but it would be incorrect to draw the conclusion that men have wings or four legs because birds are winged or dogs are four-legged.

In order to understand the nature of admissible predicates, it is necessary to investigate the logic of analogical reasoning starting from its basic component, i.e. the logic of the genus and the *topoi* related thereto (Deslauriers 2007). Aristotle defines a genus as “what is predicated in what a thing is of a number of things exhibiting differences in kind” (Aristotle, *Topics*, 102a31–32), and it is characterized in particular by the following *topos* (Aristotle, *Topics*, 121a 10–14):

Clearly, therefore, the species partake of the genera, but not the genera of the species; for the species admits the account of the genus, whereas the genus does not admit that of the species.

The species (dog) can admit the definition of the genus (animate being), but the genus cannot be defined through its species. This principle was analyzed by Boethius and explained through the following locus or rule: “Whatever is present to the genus is present to the species” (Boethius, *De Topicis Differentiis*, 1188B 21–22),² in the sense that “the essence of the genus and the accidents adhering to that essence are also part of the species” (Stump 2004, pp. 118–119). In this sense, Boethius took into account the essential predications, i.e. the predicates that either express a semantic

² In Latin: “quae generi adsunt speciei adsunt.”

feature of the genus or are related to its semantic characteristics. For instance, since animals breathe and have instincts inasmuch as they are animate beings, dogs and men breathe and have instincts. Clearly, these topics concern the characteristics that the generic concept has or may have intensionally, and not extensionally. Aristotle developed the logic of genus-species relation concerning non-essential predications by setting out the following *topoi* (Aristotle, *Topics*, 111a17–32):

In the present instance the demonstration proceeds from the genus and relates to the species; for judging is the genus of perceiving; for the man who perceives judges in a certain way.

Again, it may proceed from the species to the genus; for all the attributes that belong to the species belong to the genus as well; e.g. if there is a bad and a good knowledge there is also a bad and a good disposition; for disposition is the genus of knowledge. Now the former commonplace argument is false for purposes of establishing a view, while the second is true. For there is no necessity that all the attributes that belong to the genus should belong also to the species; for animal is winged and quadruped, but not so man. All the attributes, on the other hand, that belong to the species must of necessity belong also to the genus; for if man is good, then animal also is good. On the other hand, for purposes of overthrowing a view, the former argument is true while the latter is false; for all the attributes which do not belong to the genus do not belong to the species either; whereas all those that are wanting to the species are not of necessity wanting to the genus.

The genus-species inferences can be summarized in Table 2.

This logic of the genus and species can explain the nature of the first kind of reasoning from likeness, indicating the type of predicates that can be transferred in the inference. In particular, in order for a predicate to be transferred from the species to the genus, and from the genus to a different species thereof, it needs to be attributable to the concept that constitutes the intension of the predicate.

6 Reasoning from an Unnamed Genus

The second type of similarity is the ground of the type of reasoning that Aristotle refers to as “analogical.” Aristotle applied this type of argument to the attribution of two kinds of predicables, genus and property.

Table 2 Rules of inference in analogical reasoning

Rule of inference	Example
Whatever is present to the genus is present to the species	Animals breathe. Therefore, dogs breath
All the attributes that belong to the species belong to the genus as well	A dog is four-legged. Therefore, an animate being is four-legged
All the attributes which do not belong to the genus do not belong to the species either	An animate being is not bi-dimensional. Therefore a dog is not bi-dimensional

One use of analogical reasoning is to support the attribution of a predicate as a genus, based on an identical genus-species relation. Aristotle describes it as follows (Aristotle, *Topics*, 124a16–18):

Thus (e.g.) the relation of the pleasant to pleasure is like that of the useful to the good; for in each case the one produces the other. If therefore pleasure is essentially good, then also the pleasant will be essentially useful; for clearly it will be productive of good, seeing that pleasure is good.

The reasoning is based on a proportion, semantically conceived as a relation of “production”: the pleasant (p) is related to pleasure (P) as the useful (u) is related to the good (G). This proportion leads to an inference based on logical-semantic topics (Macagno and Walton 2009) related to the genus-species relation. The good is the accepted genus of pleasure (P is a kind of G); therefore, if “to be productive of good” corresponds to the analogical, unnamed genus of “useful,” the pleasant will be “productive of a kind of good.” For this reason, the pleasant will be a kind of useful (the useful is “to be productive of good”). The reasoning is grounded on the treatment of the unnamed analogical category “to be productive of” as a genus, namely as the generic logic-semantic property characterizing a predication. Since the relationship is presented as essential in nature, the topic of genus-species applies, and can be represented as in Table 3

This type of analogical reasoning is grounded on an abstraction, resulting in the creation of the abstract category “to be productive of.” We can consider this passage as an asymmetric or vertical relation (Bartha 2010, pp. 43–44; Hesse 1966, p. 59). The abstract concept is then used to trigger an inference aimed at attributing a predicate as a genus, and it is grounded on a horizontal relation between the analogical, unnamed genus and the generic predicate. In this specific case, the relation is essentially connected with the concept, as it establishes that what produces a generic concept is the genus of what produces a specific concept.

The other type of analogical reasoning that Aristotle describes in the *Topics* concerns the attribution of a predicate as a *property*, which is defined as “something which does not indicate the essence of a thing, but yet belongs to that thing alone, and is predicated convertibly of it” (Aristotle, *Topics*, 102a18–19). Reasoning from analogy can proceed from this type of predication as follows (Aristotle, *Topics*, 136b33–137a8):

Table 3 Structure of the reasoning from unnamed genus—species

Rule of inference	Example
All the attributes that belong to the species belong to the genus as well	The pleasure is a species of good. “To be produced” is an attribute of “pleasure.” Therefore, what produces the pleasure produces the good
Whatever is present to the genus is present to the species	The useful is “what produces the good.” “What produces the good” is the genus of “what produces the pleasure”. Therefore, the pleasure produces the good. Therefore, the pleasure is useful

[...] inasmuch as the relation of the builder towards the production of a house is like that of the doctor towards the production of health, and it is not a property of a doctor to produce health, it will not be a property of a builder to produce a house.

[...] inasmuch as the relation of a doctor towards the possession of ability to produce health is like that of a trainer towards the possession of ability to produce vigour, and it is a property of a trainer to possess the ability to produce vigour, it will be a property of a doctor to possess the ability to produce health.

This mechanism can be compared to the aforementioned analogical reasoning concerning the attribution of a genus. In this excerpt, Aristotle sets out two proportions. The first one can be expressed as “ x produces y ”, where y represents what characterizes the profession of x . The second one can be stated as “ x has the ability to produce y ,” where y represents what characterizes the profession of x . In both cases, there is a twofold abstraction from specific cases to a generic concept and its univocally identifying feature. The horizontal relation between the abstract genus (profession) and the abstract and generic predicate (to possess the ability to produce/to produce what characterizes a profession) is convertible and concerns the concepts abstracted. For this reason, the topic governing the passage of a predication from the genus to species applies (given the identity of the genus with the definite description). The reasoning that characterizes the second analogy can be represented as in Table 4

These reasoning steps hold based on specific defeasible premises, which are implicitly advanced in the analogy. First, a doctor and a trainer are regarded implicitly as both falling under the genus of “Professionals dealing with human conditions” (or another possible category indicating skilled workers having a specific duty towards animate beings). Second, the ability of producing vigor is considered explicitly as characterizing essentially the trainer. Third, the ability of

Table 4 Structure of the reasoning from unnamed genus—property

Rule of inference	Example
All the attributes that belong to the species belong to the genus as well	A Trainer has the property of having “The ability to produce vigor”. A Trainer is a Professional dealing with human conditions (Professional). Therefore, a Professional can have the property of having “The ability to produce vigor”
The objects of which the species is predicated, the genus ought to be predicated as well (121a26)	“The ability of producing what characterizes a profession” is the genus of “The ability to produce vigor.” Therefore, to have “The ability to produce what characterizes a profession” is the property of a Professional
Whatever is present to the genus is present to the species	To have “The ability to produce what characterizes a profession” is the property of a Professional. A Doctor is a Professional and health is what characterizes his profession. Therefore, a Doctor has The ability to produce health

Table 5 Structure of the reasoning from unnamed genus—negative reasoning

Rule of inference	Example
Whatever is present to the genus is present to the species	To produce health is not a property of a doctor. Therefore, to produce what characterizes a profession is not a property of the profession
All the attributes which do not belong to the genus do not belong to the species either	To produce what characterizes a profession is not a property of the profession. Therefore, to build a house is not a property of a builder

“producing a specific effect (what characterizes the profession) in the individuals on which the professional operates” is considered as characterizing the aforementioned generic category of “Professionals.” These premises can be rebutted, but what is important is that they are presented as involving specific types of predicables, which trigger specific rules of inference that warrant the reasoning.

The rules characterizing genus and species and governing analogy are different in the case of negative analogy. In the first case in the passage quoted above, an analogical genus and a generic property (to produce what characterize the profession) are abstracted, but this predication is denied because a specific predication is not the case. The logic underlying this inference is different and proceeds from a different topic. Its structure and rules (only the relevant ones) can be represented in short as in Table 5.

The dialectical treatment of analogy shows how this type of reasoning is grounded on a process of abstraction, consisting in finding a generic property common to the terms of the comparison (the two couples, in the case of the Aristotelian analogy). This abstraction of a predicate attributable as a genus to the specific terms triggers the inferences constituting the genus-species relation. In particular, analogy can be thought of as a mechanism consisting in the generalization of a predication based on a specific case, the Analogue (species-genus inference), followed by a predication in which the generic predication is attributed to the other specific instance, the Target (genus-species inference). Only some types of predication can be governed by the topics of genus and species, and in particular the ones representing a characteristic of the abstract concept (such as in the case of the attribution of a genus) or related to (motivating) its semantic features (such as in the case of the attribution of a property, which distinguishes it from all the other concepts). This type of analogical reasoning, however, is rooted in the semantic analysis of the terms of the comparison, i.e. their “essence.” In order to investigate how these dialectical mechanisms can be of help for understanding the other types of analogical reasoning, it is necessary to broaden the idea of analogical genus and adapt it to rhetorical inferences.

7 Reasoning from Accidental Similarities

The analogical inferential patterns analyzed in the *Topics* concern the attribution of predicates according to specific logical-semantic relations (genus and property) that express or are related to the semantic features of the terms of the comparison. In the

medieval tradition this type of relation was referred to as “inherent likeness” (Petrus Hispanus, *Summulae Logicales* V 34). However, as mentioned in the first section above, the relation of similarity can be also accidental, concerning the attribution of predicates that are not related to the meaning of the concepts constituting the analogical comparison. This type of reasoning is taken into account in the *Rhetoric*, where the goal is to provide arguments based on what usually happens or should happen (Cicero, *De Inventione* I, 29: 30; Quintilianus, *Institutio Oratoria*, V, 10, 16; Macagno and Damele 2013). For this reason, the mechanism of analogy is not based on semantic properties and relations, but rather on different criteria governing the abstraction of the analogical genus and its relation with the analogical predicate.

Aristotle analyzed a type of reasoning that in the later Latin and Medieval tradition was called “from proportion” and classified as a species of reasoning from likeness (Boethius, *De Topicis Differentiis*, 1202b 34–35; Buridanus, *Summulae de dialectica*, SDD 6.5.8). Aristotle called it “illustrative parallel” and described it using the following example (Aristotle, *Rhetoric*, 1393b4–1393b8):

The illustrative parallel is the sort of argument Socrates used: e.g. ‘Public officials ought not to be selected by lot. That is like using the lot to select athletes, instead of choosing those who are fit for the contest; or using the lot to select a steersman from among a ship’s crew, as if we ought to take the man on whom the lot falls, and not the man who knows most about it’.

This type of reasoning is based on a proportion: a pilot is related to a ship as a ruler to a city. However, this type of reasoning is aimed at attributing a predicate external to the comparison (in this case “not to be chosen by lot”) to the implicit, nameless genus abstracted from the relation (in this case, “performance of activities based on abilities and knowledge”). Boethius described it as “a certain likeness of relationship” (Boethius, *De Topicis Differentiis*, 1191 A 37–38). In the dialectical reasoning from likeness the similarity is between “things” (Boethius, *De Topicis Differentiis*, 1191 A 37), i.e. the concepts, and the purpose is to attribute a consequent to an antecedent based on an abstract semantic relation (such as “to possess the ability of”) between two nameless genera (such as “profession” and “activity characterizing the profession”). In rhetorical analogy, instead, the abstracted relation becomes the subject matter of a judgment.

The illustrative parallel has a structure that is identical to the rhetorical “rational correspondence,” which Aristotle illustrates as follows (Aristotle, *Rhetoric*, 1399a34–1399b5):

Another line is that of rational correspondence. E.g. Iphicrates, when they were trying to compel his son, a youth under the prescribed age, to perform one of the state duties because he was tall, said ‘If you count tall boys men, you will next be voting short men boys’. And Theodectes in his *Law* said, ‘You make citizens of such mercenaries as Strabax and Charidemus, as a reward of their merits; will you not make exiles of such citizens as those who have done irreparable harm among the mercenaries?’

A proportion is established between two distinct cases. In the first example, tallness is related to legal manhood as shortness is related to legal childhood; in the

second one, citizenship (or public reward) is related to military merits as exile (or public punishment) is related to military faults or dishonor. In both cases the proportion is based on the identity between two abstract relations, which in their turn proceed from the abstraction of generic properties, or higher genera (Hesse 1965, p. 331) from the antecedents and the consequents of the two ratios. This process of abstraction and the inferences triggered by it can be compared to the processes underlying dialectical reasoning from likeness.

The validity of the inference in dialectical analogy consisted in the relationship between the generic predicate and the meaning of the generic subject, which was presented as essential or related to the essence (such as a genus or a property), namely grounded on semantic properties (Levin 1982). In rhetorical reasoning from accidental similarity this relation cannot be essential, but is factual (Levin 1982). However, in order for the reasoning to be acceptable, the abstracted analogical genus and the predicate need to be connected, for example by a legal rule or definition as in the case above. Aristotle provides a case of unacceptable reasoning when referring to one of his predecessors, who was misled by accidental or superficial similarity. Alcmaeon of Croton (and others) thought the white of an egg was the “milk” or nourishment of an embryo, rather than the yolk. But this belief was “because of the similarity of colour” (Aristotle, *Generation of Animals*, 752b25f).

If the connection cannot be *presented* as essential, it needs at least to motivate the attribution of the predicate. In this sense, reasoning from accidental similarity can be considered as grounded on the abstraction of a functional genus, in which the relationship between the predication and the genus is “essential” only in a metaphorical and highly defeasible sense. The characteristic abstracted needs to motivate the attribution of the predicate, and the force of the inference lies in this argumentative relation. In the first example, “height” is related to “legal age” by a connection that can be described as a legal rule or definition (legal age shall be established based on a person’s height). In the second example, a rule based on values links “citizenship” or “consequences on the public status” and “military behavior.” The reasoning structure can be represented as in Table 6.

Both in illustrative parallel and rational correspondence, the relation between the two genera (the horizontal relation) is not semantic in nature; rather, it is based on an accidental relation that can be a law or a rule based on values. In the argument

Table 6 Structure of the reasoning from accidental similarities

Rule of inference	Example
All the attributes that “belong” to the species belong to the genus as well	It is unreasonable to choose a steersman by lot. Therefore, it is unreasonable to choose a person performing activities based on abilities and knowledge by lot (it motivates the specific case)
Whatever is present to the genus is present to the species	It is unreasonable to choose a person performing activities based on abilities and knowledge by lot. Therefore, it is unreasonable to select public officials by lot

analyzed in Table 6, the functional genus motivates the attribution of the predicate based on negative consequences. In this sense, the analogy consists in the selection and generalization of a specific characteristic that can warrant the required predication. The analogy does not lead to a necessary predication, but to a commitment to a general rule, which needs to be applied to a problematic and controversial case. By denying that a specific case is acceptable, the whole genus is rejected as well.

8 Reasoning from Similar States of Affairs

The last type of similarity consists in a comparison between two states of affairs, and it is aimed at supporting the attribution of a predicate to the (individual) Target based on a similar predication. Aristotle's treatment of this type of reasoning, which he calls example, can be compared to the aforementioned structure of reasoning from accidental similarity. The analogue can support the predication inasmuch as it can be placed under the same category—or functional genus—of the Target. Using the famous example by Aristotle (Aristotle, *Prior Analytics*, 69a 2–13):

For example let *A* be evil, *B* making war against neighbours, *C* Athenians against Thebans, *D* Thebans against Phocians. If then we wish to prove that to fight with the Thebans is an evil, we must assume that to fight against neighbours is an evil. Conviction of this is obtained from similar cases, e.g. that the war against the Phocians was an evil to the Thebans. Since then to fight against neighbours is an evil, and to fight against the Thebans is to fight against neighbours, it is clear that to fight against the Thebans is an evil. Now it is clear that *B* belongs to *C* and to *D* (for both are cases of making war upon one's neighbours) and that *A* belongs to *D* (for the war against the Phocians did not turn out well for the Thebans); but that *A* belongs to *B* will be proved through *D*.

This type of reasoning hinges on the abstraction of a common feature, in this case “making war against neighbors,” under which both the analogue and the Target fall. As in the reasoning structure underlying the reasoning from accidental similarity, the analogical genus needs to be pragmatically connected with the predicate that is transferred from the analogue. For instance, it would be unreasonable to draw the conclusion that “a war against the Thebans is bad” based on the fact that the two terms of the comparison share the common feature of “wars narrated in famous literary works.” This genus could not be functional, i.e. could not motivate the attribution of the predicate “to be evil.” However, differently from the reasoning from accidental similarity, the motivational relation is not found in a law or in an accepted rule. Rather, it is a possible motivational relation that *can* be considered as reasonable. It is presented as abstracted from a specific case, and valid until refuted by a contrary one. The inferential structure of this type of analogical reasoning corresponds to the one based on accidental similarities, and can be represented in Table 7.

Table 7 Structure of the reasoning from similar states of affairs

Rule of inference	Example
All the attributes that “belong” to the species belong to the genus as well	The war of the Thebans against Phocians was an evil to the Thebans—inasmuch as it was a war against neighbors. Therefore, wars against neighbors can be an evil to the aggressor
Whatever is present to the genus is present to the species	Wars against neighbors can be an evil to the aggressor. Therefore, the war of the Athenians against the Thebans can be an evil to the Athenians

The reasonableness of reasoning from example consists in the two kinds of reasoning characterizing all the other types of analogical arguments, i.e. the abstraction of a nameless genus and the triggering of the two inferences from the species to the genus and from the genus to the species. As in the third type of reasoning from similarity, and also in arguments from example, the semantic feature constituting the abstract genus is not essential, as it does not represent a semantic fundamental feature of the analogue and the Target essentially related with the predicate. The relation between the genus and the predicate is not semantic, but rather motivational (in our example, it is possible to imagine a relationship between attacking the neighbors and bad consequences or higher risks). If it is not possible to reconstruct or imagine a motivational link between the abstract genus and the predicate, this type of argument would represent merely an extremely poor induction from one case.

The functionality (or rather relevance) of the genus for the predication is not made explicit in analogical reasoning. The rhetorical force of this type of argument consists in reversing a kind of burden of persuasion. The speaker does not provide the interlocutor with the premises needed for assessing the argument. On the contrary, the interlocutor needs to reconstruct the functional genus and the motivational relation connecting it with the predicate, and attack it if it is the case. However, the reconstruction of the implicit premises and concepts presupposed by analogical arguments is matter of interpretation, which can be used strategically (Macagno and Damele 2013). The speaker is left with the possibility of reinterpreting the structure of the argument in a way that is more favorable to his own purposes—in a kind of “self straw-man.” A different functional genus can be abstracted, and a more strategically suitable argumentative, motivational link between the predicate and the abstract functional category can be provided.

9 Conclusion

Argument from analogy is a complex pattern of reasoning that can be based on different types of inferences. In order to analyze and assess analogical arguments, it is useful to distinguish between the types of inference justifying the conclusion, which in turn amounts to analyzing and distinguishing the types of similarity on which the analogy is based. In the Middle Ages, dialecticians distinguished

reasoning from proportion from reasoning from likeness, and pointed out the relationship between these two types of inference and reasoning from example. In order to analyze how these distinct and similar kinds of argument (Brown 1989) are related to each other, it is necessary to go back to Aristotle's *Topics*, and interpret from an argumentative point of view the deep logical structure of what he called "rational correspondence."

The first step consists in identifying the reasoning processes underlying analogical reasoning, i.e. what properties or features make two concepts or states of affairs similar, and what rules warrant the transfer of the predicate from an individual concept or case to the other. The kinds of similarity can be divided into four categories, depending on whether they represent fundamental semantic features of the terms of the comparison (essential similarities) or non-semantic ones, indicating possible characteristics of the referents (accidental similarities). In turn, these two categories can be divided into two groups, depending on whether the essential similarity is known with a name (1), or unnamed (2), and whether the accidental one concerns generalizations (3) or specific instances (4).

These distinct types of analogical arguments are characterized by a similar general structure, grounded on the process of abstracting a common genus, i.e. a common characteristic that becomes the feature under which different concepts fall. This abstraction is the basis for the application of the *topoi*, or rules of inference, governing the attribution of the analogical predicate to the genus and to the Target. In this sense, the abstracted genus needs to justify the attribution of the predicate, and depending on the type of similarity, the relationship between genus and predicate is different. In the reasoning based on essential similarities (1 and 2), a semantic feature is singled out and abstracted, which is related to the meaning of the analogical predicate. In case of reasoning from accidental similarities (3 and 4) the relation between the analogical genus and the predicate is rather one of motivation, a non-semantic relation that can be grounded on values, causes, or other types of premises. Such premises can be commonly accepted as shared rules (3) or used as possible explanations of a specific state of affairs (4).

These distinctions, summarized in Fig. 1 above, can be used within the theory of argumentation schemes (Walton et al. 2008) as instruments for analyzing the structure and the force of an analogy and an analogical inference (as represented in the argumentation scheme from analogy in the introduction). The analysis of the type of similarity can be considered as a criterion for evaluating the "major premise" of the scheme (*C1* is similar to *C2*). By distinguishing whether the similarity is essential or accidental, and whether it concerns generalizations or simply singular instances, it is possible to determine whether the force of the conclusion is consistent with the acceptability of the premise (essential similarities can warrant strong conclusions, but not accidental ones concerning individual cases). It is possible to represent this first distinction in terms of a first set of critical questions:

1. What kind of similarity characterizes the relationship between the Target and the Analogue?

- a. Is it an essential (semantic) similarity or an accidental one (concerning the referents of the concept)?
- b. If it is essential, does it represent an existing category or a new (unnamed) one?
- c. If it is accidental, does it concern generalizations or specific instances (individual beings or events)?

The second type of distinction concerns the relationship between the common characteristic (the functional genus) and the predicate that is transferred from the Analogue to the Target. This type of distinction can be used to assess the relationship between the “minor premise” of the scheme (*A* is true (false) in case *C1*) and the conclusion (*A* is true (false) in case *C2*). The predicate can be a semantic property or a motivational relation that can be shared or not; in this latter case, it can be simply suggested (abduced by the interlocutor) for explaining the analogy, without providing any ground for it apart from a previous case. These differences can be elicited by a second set of critical questions, aimed at analyzing whether the conclusion is warranted and how:

2. How is the common characteristic (functional genus) related to the predicate attributed to the Analogue and the Target?
 - a. Is this relationship semantic, or is it a rule?
 - b. If it is a rule, is it a shared one or is it provided to explain the specific case?
 - c. If it is a shared rule, what kind of rule is it?

Both sets of questions bring to light the defeasibility conditions that characterize the various types of argument from analogy. Depending on the kind of similarity, the inference will be less or more subject to default. For this reason, determining the type of similarity (semantic/factual) and the ground thereof (accepted rules or an abduced one) can lead to assessing the strength of an analogy in a systematic manner.

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