Common knowledge in argumentation

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DOUGLAS WALTON* & FABRIZIO MACAGNO**

COMMON KNOWLEDGE IN ARGUMENTATION[1]

We argue that common knowledge, of the kind used in reasoning in law and computing is best analyzed using a dialogue model of argumentation (Walton & Krabbe 1995). In this model, implicit premises resting on common knowledge are analyzed as *endoxa* or widely accepted opinions and generalizations (Tardini 2005). We argue that, in this sense, common knowledge is not really knowledge and/or belief of the epistemic kind studied in current epistemology. This paper takes a different approach, defining it in relation to a common commitment store of two participants in a rule-governed dialogue in which two parties engage in rational argumentation (Jackson & Jacobs 1980; van Eemeren & Grootendorst 2004). A theme of the paper is how arguments containing common knowledge premises can be studied with the help of argumentation schemes for arguments from generally accepted opinion and expert opinion. It is argued that common knowledge is a species of provisional acceptance of a premise that is not in dispute at a given point in a dialogue, but may later be defeated as the discussion proceeds.

Keywords: enthymemes, defeasible reasoning, generalizations, evidence, generally accepted opinions, legal argumentation, metadialogues.

* University of Winnipeg, d.walton@uwinnipeg.ca
** Università Cattolica, Milan, fabriziomacagno@hotmail.com
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Common knowledge is important in rhetoric (Goulding 1965; Tardini 2005) logic (Kaneko et al. 2002), artificial intelligence (Singh et al. 2002), game theory (Morris & Shin 1997) economics (Fagin et al. 1999), psychology (Schank & Abelson 1977), sociology, and legal reasoning (Anderson & Twining 1991). Common knowledge is also fundamentally important in argumentation theory (van Eemeren & Grootendorst 2004), in the study of notions like conversational argument (Jackson & Jacobs 1980), presumption, implicit premises (Hitchcock 1985; Tardini 2005) defeasible reasoning (Prakken 2001), and informal fallacies in logic, particularly the traditional fallacy of *argumentum ad populum*, or argument from accepted opinion (Freeman 1995; Walton 1999). Since the time of Aristotle, common knowledge has been linked to the problem of enthymemes, or arguments with missing premises (or conclusions) that need to be filled in order to complete the argument (Ennis 1982; Walton 2001). However, the precise linkage between these two notions has been clouded with controversies (Barnes 1980; Bolton 1990; Devereux 1990). In this paper, we cannot try to resolve the disagreement about enthymemes, but we do bring out how they are related to the notion of common knowledge in important ways.

The term "common knowledge" is highly problematic, since different kinds of accounts have been given in different fields like logic, artificial intelligence, game theory, law and argumentation. We can notice, however, that the models of knowledge stemming from logic cannot be actually applied to analysis of human reasoning in discourse. While in logic common knowledge is analyzed as necessarily connected to truth, in artificial intelligence (AI) systems and law it is described as provisional, leading only to defeasible inferences (Walton & Macagno, 2005). In argumentation a definition of common knowledge can be reached from the role the latter plays in the enthymeme. Starting from the description of the concept of *endoxon* given in the ancient tradition, in this paper common knowledge is associated with the common ground notion of linguistics and the dialectical notion of commitment. This analysis of common knowledge will allow us to take into account not only the missing premises of argumentation schemes but also the implicit propositions that are involved in a dialogue, from dialogical rules to linguistic presuppositions. This treatment of common knowledge, derived from defeasible reasoning, can be applied to legal discussions and to models of dialogue of the kind increasingly found to be useful in AI.

1. Common Knowledge in Logic and other Disciplines

In this section, logic, law, game theory and artificial intelligences are taken into consideration as starting points for a description of the notion of common knowledge. Common knowledge connects these fields to argumentation theory and they constitute different perspectives on it, providing the background for our approach. In particular, our aim is to highlight the connection between the treatment of knowledge in a discipline and the role it plays in it. While the bare logical account of common knowledge is abstracted from any application, any deeper description of it becomes more and more complex when the factors of interaction, such as agents (in game theory), language and inference (computing), context and community (law) are taken into consideration. We can observe that the underlying notions of logical entailment and the Bayesian statistical calculus is replaced in these latter models by the notion of defeasible or provisional consequence. The starting point for our proposal is this very notion of defeasible inference.

1.1. The Epistemic Meaning of Knowledge

Since the Enlightenment, philosophers have widely held the view that to be knowledge a proposition must be proved beyond doubt. But as the term 'knowledge' is used in information technology, especially as applied to legal reasoning, this definition is based on certain rationality assumptions. There is a sense of 'knowledge' widely accepted in analytical philosophy that puts strong rationality requirements on knowledge like the following axiom: if A is known to be true then A is true.[2] This rationality assumption represents what could be called the epistemic meaning of knowledge, modeled using the knowledge operator (K) in epistemic modal logics as axiom 1.

Axiom 1: $\underset{i}{K} A \supset A$

Axiom 1 rules that if an agent knows that A, then A is true. In other words, it says that no false proposition can ever be known to be true. Additional axioms concern iterated modalities like the rationality assumption that an agent knows all the logical consequences of any statement that it knows.

[2] We take the capital letters A, B, ..., to refer to statements. We also call them propositions, taking the two terms to be equivalent, for our purposes in this paper.

Axiom 2: $K_i A \supset K_i K_i A$

Axiom 2 says that if an agent knows A to be true then it knows that it knows that A is true. These conditions could represent a notion of knowledge that does apply in some restricted contexts, perhaps in mechanized mathematical reasoning based on deductive logic, for example. They might even represent scientific argumentation modeled at a high level of theoretical abstraction. But they make the expression 'common knowledge' an oxymoron.

If we look at real cases of how assumptions based on common knowledge are made in science and law, the epistemic notion is too strong to represent common knowledge in these kinds of argumentation. In such cases, the argumentation is based on defeasible generalizations that might turn out to default in exceptional cases as more information is discovered, and might therefore turn out to be false, as applied to the given case. In many cases, the agents accept a premise on the basis of common knowledge, even though they are not realistically in a position to verify it, or to prove it by examining the scientific evidence relevant to evaluating it as objectively true. They just accept it, because it is not really in dispute at the present stage of a discussion or investigation, because it is generally accepted, and because there is no reason not to accept it. Thus a proposition could reasonably be accepted on the basis of common knowledge, even though it did not conform to any of the axioms for knowledge or belief cited above. The analysis of common knowledge based on some combination of the axioms for epistemic logics cited above could be called the strong epistemic analysis, indicating that they model knowledge as logically infallible.

If one gives up on the strong epistemic analysis of common knowledge as too idealistic or fixed to represent a general view, an alternative is to define it in terms of belief. Belief does not imply truth. It only implies that the agent believes that the statement in question is true. In this sense, something is common knowledge if everybody believes that it is true, everybody believes that everybody believes that it is true and so forth. This characterization represents what could be called the doxastic view of common knowledge. One objection to it is that belief appears to be psychological, making it hard to judge what an agent really believes without conducting empirical investigations or doing psychological testing[3].

[3] Perhaps what is meant is rational belief, as opposed to actual belief. But how is rational

1.2. Common Knowledge in Game Theory

In science, something is said to be common knowledge among a group of agents if all know it, all know that all know it, and so on (Morris & Shin 1997: 171). In game theory and economics, common knowledge is necessary to achieve the kind of co-ordination needed in a distributed system in which a group of agents must jointly carry out an intelligent action (Kaneko et al. 2002). This definition came from David Lewis' book (1969), according to Verbrugge (1999: 2), who offered the following example to illustrate how it works.

> What kind of knowledge is needed for every driver to feel reasonably safe? The fact that all Dutch drivers drive on the right side of the road by itself is not enough to make them feel safe: they would want to know that all other drivers drive on the right side, as well. Now imagine that everyone drives on the right because they know that all the others do, but that everyone holds the following false belief: "except for myself, everyone else drives on the right just by habit, and would continue to do so no matter what he expected others to do". Lewis argues that in this imaginary situation one cannot really say that there is a convention to drive on the right. Lewis proposes that if there is a convention among a group that φ, then everyone knows φ, everyone knows that everyone knows φ, and so on ad infinitum. In such a case we say that the group has common knowledge of φ.

This principle has been applied to the game theory in economics and statistics, after being formalized by Aumann (1976). The latter points out that the mere assumption of knowledge is not sufficient in game theory: two people must trust each other in order for the event to be considered common knowledge (Aumann 1976: 1236). This notion is pivotal in Aumann's account of subjective probability. This statistical principle proceeds from the observation that, in order for two commonly known data to be equally considered by two persons and lead to identical conclusions, not only must the data (the posterior) of a probabilistic calculus be common knowledge, but also the reasons leading to it (the priors). The data, depending on their grounds, can be differently taken into consideration for a conclusion. The logical notion of truth implied by the notion of

belief to be defined? Here once again questions are raised that seem hard to answer. If an agent rationally believes *A*, does the agent also have to believe all the logical consequences of *A*? If an agent believes *A*, does the agent also have to believe that she believes *A*? Such questions have proved puzzling, and hard to answer (Fagin et al. 1999).

common knowledge conflicts with the subjective idea of reliability of the datum, involving a more complex concept of "commonly known event".

1.3. Common Knowledge in Artificial Intelligence

Another definition of common knowledge comes from artificial intelligence. When trying to build machines that can carry out reasoning tasks of various kinds the researchers quickly found out that much practical everyday reasoning is based on common knowledge of a kind that computers do not grasp in the same way that human reasoners do. When researchers tried to represent this common knowledge in an explicit fashion for programming computers, they began to appreciate the vast amount of implicit knowledge that all human beings share, and that their reasoning and communication is based on. For example, we all know that if President Bush is in Washington then his head is also in Washington, and that if a father has a son, the son is younger than the father. But a computer has to be programmed to possess such knowledge, and use it in reasoning. Everyday conversational reasoning also often depends on such implicit premises that are taken for granted by all parties to argumentation.

The open mind common sense system (OMCS)[4] is a common sense knowledge acquisition system that the general public can take part in, by contributing facts, rules stories and descriptions. Some of the items collected include the following statements (Singh et al. 2002: 3).

> People do not like being repeatedly interrupted.
> If you hold a knife by its blade then it may cut you.
> People pay taxi drivers to drive them places.

Note that all three of these statements are generalizations of a kind called defeasible in computing (Prakken 2001a). They may hold generally, but be defeated in specific cases by exceptions to the rule, only some of which can be anticipated in advance. It is a common knowledge generalization that birds fly, for example. But it will be defeated if the bird is a penguin, or in a case where the bird has a broken wing. This classic example illustrates how defeasible reasoning works in computing (Prakken 2001b). It also shows how defeasible reasoning is connected with common knowledge generalizations.

Our view is that while the game theory notion of common knowledge may prove to be useful in the future, it is too complex to be a good begin-

[4] http://commonsense.media.mit.edu/cgi-bin/search.cgi

ning point for studying how common knowledge works as a device in argumentation. Our approach will be to start with the notion of common knowledge found in artificial intelligence, like that in OMCS, and to take it as our beginning point for an analysis of common knowledge in argumentation.

1.4. Common Knowledge in Law

We have shown in another paper (Walton & Macagno 2005) how common knowledge is important in legal reasoning, especially in two ways. First, common knowledge is the basis of many legal generalizations that play critical roles in arguments about evidence in trial (Bex et al. 2003). Second, common knowledge is often assumed in implicit premises in legal reasoning. Let us consider common knowledge in generalizations first. Anderson and Twining (1991: 368-369) identified five types of such generalizations that are especially common in legal reasoning.

(1) Case specific generalizations are those that are or may be established in a particular case, like "in most matters concerning their relationship, Edith dominated Freddie".
(2) Scientific generalizations (p. 368) state laws of science, like the law of gravity.
(3) General knowledge generalizations are widely known in a particular community, like "Palm trees, rain, and high humidity are common in Miami, Florida" (1991: 368-369).
(4) Experience-based generalizations rest on common knowledge about events and actions familiar to many, like "Someone who has been unfairly treated by the police, may, rightly or wrongly, conclude that police officers are not to be trusted" (1991: 369).
(5) Belief generalizations are based on superficial impressions rather than direct experience (1991: 369), for example: "Most Poles are devoted Catholics", but can also be prejudices based on stereotypes.

Now let us see how common knowledge is often assumed in implicit premises in legal reasoning. Implicit premises in legal argumentation can be taken for granted in some cases because it can be reasonably assumed that they are likely to be disputed. The following example is from Cicero's *De Inventione* (1993: 107).

> There is no point in requiring proof or demonstration of a premise which contains a plain statement which must be granted by everyone. The follow-

> ing example: "If I was in Athens on the day on which the murder was committed at Rome, I could not have been present at the murder." Because this is obviously true, there is no point in having it proved. Therefore we should pass immediately to the minor premise, as follows: "But I was at Athens that day." If it is not granted, it needs proof, after which the conclusion follows. There is, therefore, a kind of major premise which does not need proof. What, then, is the point of showing that there is a premise which does need proof, for that can easily be seen by everyone?

The minor premise is the statement that the accused was in Athens on a certain day. This statement needs to be proved by witness testimony. The major premise is the statement that if he was in Athens on the day on which the murder was committed at Rome, he could not have been present at the murder.

Major Premise: If I was in Athens on the day on which the murder was committed at Rome, I could not have been present at the murder.
Minor Premise: I was in Athens on the day on which the murder was committed at Rome.
Conclusion: Therefore I could not have been present at the murder.

The major premise is a defeasible rule that holds in the given case in virtue of common knowledge, but is subject to defeat as circumstances might change in a different case. As we all know, now it is possible, or even routine, to be in Athens and Rome on the same day. Thus the major premise, acceptable as common knowledge in Cicero's time, nowadays would have to be proved by presenting an argument indicating special circumstances that would make it true.

Common knowledge is appealed to in legal argumentation through the device of judicial notice in a trial. Judicial notice is a tool that a lawyer can use to prove a fact that is important for his argument but is not easily proved by calling a witness (Park, Leonard & Goldberg 1998: 45). According to *McCormick on Evidence* (Strong 1992: 388), "the oldest and plainest ground for judicial notice is that the fact is so commonly known in the community as to make it unprofitable to require proof, and so certainly known as to make it indisputable among reasonable men." But is this a kind of common knowledge, or it is really just a form of asking disputants to accept a proposition that is not worth disputing?

1.5. Background for a New Definition of Common Knowledge

If we look at real cases of how assumptions based on common knowledge are made in science and law, the epistemic notion is too strong to represent common knowledge in these kinds of argumentation. In such cases, the argumentation is based on defeasible generalizations that might turn out to default in exceptional cases as more information is discovered, and might therefore turn out to be false, as applied to the given case. In many cases, the agents accept a premise on the basis of common knowledge, even though they are not realistically in a position to verify it, or to prove it by examining the scientific evidence relevant to evaluating it as objectively true. They just accept it, because it is not really in dispute at the present stage of a discussion or investigation, because it is generally accepted, and because there is no reason not to accept it. Thus, it could reasonably be accepted on the basis of common knowledge, even though it did not conform to any of the axioms for knowledge or belief cited above.

2. The Role of Common Knowledge in Argumentation

If we examine actual cases of arguments in which premises or conclusions based on common knowledge are included as parts of the argument, they do not tend to be statements that are known by the participants in the epistemic sense. Rather they are statements that are merely accepted "for the sake of argument", because nobody seriously doubts them, and they are not really central to what is being disputed or investigated (Jackson & Jacobs 1980). Such cases are reminiscent of the older notions of *endoxa* from Greek philosophy and of the unconventional view of the Aristotelian enthymeme. In the last section of this second part of the paper, the argument schemes and the fallacies connected to the notion of common knowledge are examined, in order to highlight fundamental characteristics of common knowledge in argumentation.

2.1. Common Knowledge in Enthymemes

According to the conventional definition, an enthymeme is an argument that contains a missing (unstated) premise or conclusion, that, once made explicit, completes the argument, making it valid (Goulding 1965). In his leading textbook, Hurley (2000: 289) defined an enthymeme as "an argument that is expressible as a categorical syllogism

but that is missing a premise or a conclusion." He offered the following example: "The corporate tax should be abolished; it encourages waste and high prices." (Hurley 2000: 289), with the missing premise, "Whatever encourages waste and high prices should be abolished." Opposed to this conventional view, is the view of Sir William Hamilton who argued (1874: 389) that an enthymeme is a syllogism based on "signs and likelihoods". Hamilton argued that not all Aristotelian syllogisms are of the deductively valid kind. H.W.B. Joseph (1916: 350) joined in this view when he hypothesized that Aristotle saw an enthymeme as an argument based on a defeasible generalization, "a general proposition true only for the most part, such as that raw foods are unwholesome." We do not take sides on this issue here, but only mention it is passing. Others who have supported this view include Barnes (1980), and the issue is discussed by Bolton (1987) and Devereux (1987). We will continue to use the term 'enthymeme' in the conventional sense in the literature on logic, represented by Ennis (1982) Gough and Tindale (1985), and Govier (1992).

In many cases, enthymemes depend on premises that are implicit but acceptable because they represent common knowledge (Walton 2001). To cite an example from (Walton 2001), we all know, or can be assumed to know as common knowledge, that soup is normally eaten with a spoon, and not a fork. This premise is assumed as common knowledge in the following example of an argument, quoted from (Acock 1985: 106).

The Risi e Bisi Example

> Risi e bisi is often listed on menus among the soups, and some gastronomic writers dare to call it one. Nonsense! It is served with a fork. Who ever heard of eating soup with a fork? (Risi e bisi, *The Best of Italian Cooking*, Waverly Root: 219).

The argument in this example is meant to be a refutation of the claim apparently made by some that risi e bisi is a soup. An explicit premise of the argument is that risi e bisi is served with a fork. The rhetorical question, "Who ever heard of eating soup with a fork?" can be assumed to make the statement that nobody eats soup with a fork (as a general practice). So analyzed, there are two non-explicit assumptions on which the argument depends.

1. If something is served with a fork, and nobody eats soup with a fork, then what was served is not soup.

When 1 is made explicit as a premise that risi e bisi the following implicit conclusion can be drawn.

Risi e bisi is not a soup.

In this instance, non-explicit assumption 2 is a conclusion.

To analyze the argument, we need to be aware that it is common knowledge that soup is normally not eaten with a fork, and that a restaurant will generally try to furnish a diner with the appropriate utensil for eating. But it is also common knowledge that eating soup with a fork would not be practical, and hence we can infer that if something is served with a fork, it is not being treated as soup.

In such a case however, we argue that the basis of the enthymeme is not knowledge, in a certain epistemic sense, but common knowledge of everyday routines of serving and eating food, of the kind called a script in artificial intelligence (Schank & Abelson 1977). On this analysis, we will argue, common knowledge is indeed an important basis for the enthymeme, but there is an important sense in which it is not knowledge, or at least knowledge in the meaning conventionally meant in epistemology, but a kind of commonly accepted opinion or standard way of carrying out an action.

2.1.1. Common Knowledge and Endoxa in Greek Philosophy and Rhetoric

Common knowledge is, as we have shown, the basis of many kinds of generalizations often used as warrants in legal and everyday reasoning. There is a history behind the linkage among schemes and common knowledge in the traditional notions of *topos*, *endoxon* and *koina* in Greek philosophy and rhetoric. We can describe *topoi* as general patterns of reasoning, similar to argumentation schemes. The pattern or matrix for the inference must be distinguished, however, from the major premise. One such premise is that of the *endoxon*, on what is accepted as true, "the reputable things" (Barnes 1980: 500). *Endoxa* are a component of the common ground of a community, and have an important function in grounding a standpoint in argumentation (Tardini 2005: 284):

> *Endoxa* are the parts of the common ground of a community that become relevant in actual arguments; they are the portion of the shared knowledge and of the common beliefs of a community that is activated in the argumentative interaction in order to let the argument proceed and the standpoint be supported.

Endoxa are distinguished from *koina*, premises that are universally common and intelligible. General matrices of inference (or common axioms) that are universal and universally accepted are *koina*, while the particular *topos* and premises must only be held by the answerer. Aristotle distinguished between the common *topoi*, general rules that state how to link specific knowledge, and the particular *topoi*, shared within specific fields or communities and that are peculiar to a subject (Tardini 2005: 285). The distinction between general and particular *topoi* was common in the medieval tradition.

Topoi are the progenitors of modern-day defeasible argumentation schemes. Below, we will show how certain argumentation schemes are especially important in helping to understand how common knowledge can be taken as providing both premises and modes of reasoning that are common in everyday argumentation. They are based on *endoxa*, on propositions known by the majority, or presumed between the interlocutors, opinions accepted by all, or by the wise. They are translated as "reputable things" by Barnes (1980: 500). *Endoxa* represent what is apparent to everyone, to most people, or to the wise. What is universally accepted is practically unchallengeable, while the majority view can conflict with other widely accepted opinions. At least, what is accepted by the wise is usually granted only if it is not opposed to general opinion (Bolton 1990: 208). Aristotle defined the word so that the opinions of the mad, the sick, and peculiar of the *polloi*, must be ignored (Barnes 1980: 504). Merely shared opinions, propositions like prejudices, proverbs, cannot therefore be held as strongly reputable opinions, and the conclusions following from them cannot be deemed close to the truth but only persuasive. They are presumptions or propositions accepted in absence of better opinion, and susceptible to prejudice or fallacy (Bolton 1990: 201). The word 'opinion' means something different from knowledge.

As Bolton (1990: 221) interprets the Aristotelian text, "the body of common or accredited opinion on a subject fixes the reference of the name of the subject in such a way that it is a logical presupposition of successful reference to that subject that most, and the most intelligible parts to us, of that body of opinion are not false of that subject, or, more strongly, are explained by the basic principles of that subject." Some of these beliefs have therefore this kind of reference-fixing status. In addition, "in the account of what we signify by a name, a certain group of the features which we take to belong to what the name denotes will be included" (Bolton 1990: 222). Such generalizations are like rules of

thumb for orienting actions based on traditional experiences. Prototypes and propositions provisionally true (*endoxa*) lead defeasibly to conclusions that are provisionally true. In other words, they are provisionally accepted opinions, based on the given information then available.

The main problem lies in the determination of what is *endoxon* and what is simply opinion, or popular point of view. Hence there are questions on whether what we have described above under the label of common knowledge really is knowledge, in some strict philosophical sense, or whether it only represents opinion or acceptance. The most important connection that has emerged is the connection between the enthymeme as a type of argument where the missing premise or conclusion represents common knowledge and the *endoxon* as representing this kind of common knowledge. Both of these notions, in turn, are now linked to the *topos*, or inferential structure of the commonplace types of argument, and the concept of the defeasible generalization of the kind taken to represent common knowledge. What is most exciting with the synergy of these connections is the relationship to the current study of defeasible argumentation schemes. As shown in the next section, in this connection there are especially two types of argumentation schemes (Walton 1996; Walton 1997) that are important to consider.

2.1.2. Argumentation Schemes and Fallacies

Recent work in argumentation theory has identified two argumentation schemes that are especially important for any project of analyzing argumentation based on assumptions about common knowledge. One is argument from expert opinion. The other is argument from accepted opinion of the kind traditionally called popular opinion. Both types of argument have traditionally been considered to be fallacious in logic, but recent research has identified many cases in which arguments of these types can be held to be reasonable under the right conditions and if used in the right conditions, especially if they are seen as defeasible (Verheij 2005). Such arguments are also very common and significant in law, where they have been called necessary but dangerous (Twining 1999).

One is the argument form expert opinion. The scheme representing argument from expert opinion was formulated in Walton (1997: 210) as follows.

a. Argument from Expert Opinion

Source *E* is an expert in subject domain *S* containing proposition *A*.

E asserts that proposition *A* (in domain *S*) is true (false).

A may plausibly be taken to be true (false).

This form of argumentation is defeasible, and can default when any one of six basic critical questions is asked in a discussion (Walton 1997: 223).

CQ_1. *Expertise Question*: How credible is *E* as an expert source?
CQ_2. *Field Question*: Is *E* an expert in the field that *A* is in?
CQ_3. *Opinion Question*: What did *E* assert that implies *A*?
CQ_4. *Trustworthiness Question*: Is *E* personally reliable as a source?
CQ_5 *Consistency Question*: Is *A* consistent with what other experts assert?
CQ_6. *Backup Evidence Question*: Is *E*'s assertion based on evidence?

When a critical question is asked, the arguer using the scheme takes on a burden of proof to back up her argument by offering an appropriate answer to the question. Otherwise the argument from expert opinion defaults.

In many common cases of argumentation, a premise or conclusion is accepted on the basis of common knowledge because the experts accept it. That is, the statement in question is generally accepted by the community of experts in the scientific field in question. The arguers in the primary argument at issue may not themselves be scientific experts. Thus, they are not in a position to know whether the statement in question is true or false, based on their examination and evaluation of the scientific evidence. The statement is accepted as common knowledge and not disputed, not because the arguer or critical questioner directly know it to be true or rationally believe it themselves. They may just agree to accept it because they have no reason to dispute it. Or, in some instances, they may raise critical questions, or even dispute the claim, for example by bringing in opposing expert opinions. It's not really a matter of knowledge or belief, as such. It's more a matter of what is worth challenging, in light of how plausible the statement is in itself, and how important it is in either building one's own case or attacking that of one's opponent. The *ad populum* variant of the expert opinion scheme can be represented as follows (Walton 1999: 224):

b. Expert Opinion Ad Populum *Argument*

Everybody in this group *G* accepts *A*.
G is a group of experts in domain of knowledge.
Therefore *A* is true.

In other cases, what is accepted without challenge as common knowledge is taken for granted on an even weaker basis than expert opinion. Often statements function as implicit premises in argumentation on the basis that they are generally accepted by the majority, whether the wise, or the experts, also accept them. In Walton (1999), it is argued that the form of argument, traditionally known as appeal to popular opinion or argument from popular opinion (*argumentum ad populum*), is not inherently fallacious, but is based on a set of argumentation schemes that can represent reasonable arguments in many instances. However, such arguments tend to be inherently weak, and often derive what strength they have from being allied with stronger forms of argument, like appeal to expert opinion. Some of these schemes are based on what might appropriately be called common knowledge. To assess this claim, we have to consider the formulations of them in Walton (1999: 223-226). There is a positive form and a negative form.

Argument from Popularity

c. Positive Form

Everybody accepts that *A* is true.
Therefore, *A* is true.

d. Negative Form

Nobody accepts that *A* is true.
Therefore, *A* is false.

This form of argument is very weak, as it stands, but can carry a weight of presumption in cases of incomplete knowledge where a decision needs to be made on whether to provisionally accept a proposition as a basis for action, or for continuing a dialogue. Obviously such an argument is not conclusive, but it can carry weight.

These forms of argumentation can be used in various ways. In Aristotle, we can find the same device used not to confute the opponent's

thesis, but to induce the public to agree with the speaker's statement (*Rhetoric* III, 7, 1408a: 31-37):

> Again, some impression is made upon an audience by a device which speech-writers employ to nauseous excess, when they say 'Who does not know this?' or 'It is known to everybody.' The hearer is ashamed of his ignorance, and agrees with the speaker, so as to have a share of the knowledge that everybody else possesses.

As tradition has made abundantly clear, such arguments can be fallacious in some instances. However they do not turn out to be fallacious for any single reason. Sometimes they are strong but irrelevant arguments. Sometimes they are weak arguments that should be critically questioned but may have some worth if they stand up to the questioning. Sometimes they use deceptive tactics of various kinds to try to win over an audience by appealing to group affiliations or prejudices, not leaving room for critical questioning. A key tool for analyzing and evaluating particular cases of *ad populum* arguments is the set of critical questions matching the scheme. For example, the following set of critical questions matching the one scheme was cited in (Walton 1996: 226).

Critical Questions for Expert Opinion Ad Populum Argument

CQ_1: Does a large majority of the cited reference group accept *A* as true?
CQ_2: Is there other relevant evidence available that would support the assumption that *A* is not true?
CQ_3: What reason is there for thinking that the view of this large majority is likely to be right?

The problem posed by considering these argumentation schemes is that instances of them tend to be weak arguments, in many cases, that should properly be considered to be open to crucial questioning. In other cases, such *ad populum* arguments can even rightly be judged to be fallacious. Several of these schemes can be taken to represent the idea of an argument based on common knowledge, especially schemes *c* and *d* above. In such cases, the mere aggregate of popular acceptance is bolstered by other argumentation. For example, in the case of scheme *b*, the expert opinion *ad populum* argument, popular acceptance is bolstered by its inclusion of expert opinion, which could be taken to represent knowledge.

This evidence of many arguments that are based on appeals to popular opinion suggests that the basing of arguments on what is taken to be

common knowledge is a hypothesis that needs to be re-examined. If such arguments can be fallacious in some instances, a very careful look needs to be taken at the question of how they can be justified in cases where they are not fallacious. How can such arguments be secured and justified when they are reasonable? They represent parts of arguments that can be taken for granted provisionally because they are accepted by the majority, and also in some cases by the wise, and either because both sides are committed to them or have no reason to dispute them. The standing of such assumptions is not exclusively a matter of what is known or believed, but a matter of what is worth disputing in light of various factors. One is the issue being disputed – that is, the conflict of opinions, or what is to be proved by either side. Another is the type of dialogue or conversation, whether it is a critical discussion, for example, or a scientific investigation. Another is what is important and central to the line of argumentation on each side, determining what can be accepted casually versus what needs to be vigorously disputed or questioned. We will conclude in the last section that it is a matter of commitment rather than knowledge, and a matter of what can be reasonably taken to follow from an arguer's commitments in a dialogue, using argumentation schemes.

3. The Commitment Model of Common Knowledge

As shown by the accounts analyzed above, common knowledge is not well analyzed as a kind of knowledge represented by the game-theoretic model of David Lewis or by the epistemic models of knowledge and belief found in recent analytical philosophy. Where else could we turn? There are two philosophical theories that show promise. According to the Belief-Desire-Intention (BDI) theory, an agent has a set of beliefs that are constantly being updated by sensory input from its environment. It receives data from this environment that continually updates its beliefs. Along with these beliefs, the agent also has desires (wants) that are evaluated and form intentions. An intention is seen as a persistent goal, one that is not easily given up. The commitment-based theory (Walton & Krabbe 1995) can be contrasted with the BDI theory (Paglieri & Castelfranchi 2005). The two models differ in that a commitment is not necessarily a belief. Belief may imply commitment, but not vice versa. Belief is a private psychological notion whereas commitment is public, and is a procedural notion based on dialogue rules. Knowledge and belief refer to internal states of an agent. Both are different from commitments of an agent.

3.1. The Commitment Model

The commitment theory is based on Hamblin's dialogue models (Hamblin 1970; 1971). Two agents interact with each other verbally in a dialogue in which they are taken to have what is called a commitment store containing all the statements that the participant has conceded or accepted during the course of the dialogue (Hamblin 1970; Walton & Krabbe 1995). How does one determine whether a given statement is a commitment of a participant? A record is kept of all assertions and retractions made by that party during the course of the exchange and, at any given move in the dialogue, rules govern which statements must be inserted into or retracted from that set, depending on the type of move made. For example, if a party says 'I assert *A*', *A* goes into her commitment set. If she says 'I retract *A*', *A* is deleted from her commitment set. In Walton and Krabbe (1995), the commitments are described as depending on the type of dialogue the interlocutors are involved in: for instance, in certain types of dialogue it is possible to retract the commitment to an assertion without any effect on the outcome of the discussion, while in other contexts the rules do not allow any retraction.

Along with commitments explicitly deriving from speech acts, hidden commitments are considered as well. These represent "a participant's deeper or more fundamental commitments that she brings to the dialogue" (Walton & Krabbe 1995: 11). These are not usually brought into light during the course of a dialogue, but it is possible for the participants to challenge both their retraction and their insertion in the commitment store. Dark side commitments are deeply related to the concept of common knowledge in argumentation. In this perspective, the latter is described as a set of propositions deemed to be commitments of both the interlocutors. It is not necessary to state these propositions. Since they are taken for granted, they are considered already accepted. In linguistics they are treated as the common ground, the information the participants in a discussion are supposed to possess as members of the community of speakers (Rigotti 2005; Rocci 2005). These propositions assume linguistic competency (such as knowledge about the meaning of words...), and dialectical rules based on shared knowledge of about familiar aspects of the world and common opinions. We can analyse the example from Cicero quoted in section 1.4 in order to illustrate how commitments are related to common knowledge and to dialogue.

Table I: Commitment Analysis of the Cicero Example

White	Commitments White	Black	Commitments Black
1. I was in Athens on the day on which the murder was committed at Rome. Therefore I could not have been present at the murder.	a. Commitments stemming from what has been posited. 1. I was in Athens on the da y of the murder... 2. I could not have been present at the murder		
	Dark side commitments		
	b. Commitments based on the linguistic presuppositions and knowledge of the world 1. A murder was committed at Rome 2. If I was in Athens on the day on which the murder was committed at Rome, I could not have been present at the murder 3. It is not possible to be in Athens and Rome on the same day .		b.1 b.2 b.3
	c. Commitments based on dialogical rules 1. White can be asked to prove his assertion		c. 1

In this example, the relation between common knowledge and commitment is made clear. There are propositions the speaker can take for granted since they are presumed to be accepted by and shared with the hearer. In arguments based on common knowledge, commitment is determined by the fact that the respondent is supposed to accept the proposition on the basis that, since it is an opinion commonly held by the community, there is no need to prove it. In other words, the fact that the community has accepted it is considered to be a sufficient reason to consider it true, or at least to accept it as true for the purposes of a dialogue.

3.2. Common Knowledge and Metadialogues

It is possible, on the other hand, to reject commitment to some of these propositions, giving rise to a dialogue on a higher level, a metadialogue on the argumentation that took place in the original dialogue. Such problems can arise, for example, when a respondent interrupts the dialogue to make a challenge about burden of proof. For example, in an argument from expert opinion, as shown in (Bex et al. 2003), the expert is presumably considered not to be biased. Indeed, the plausibility of an argument from expert opinion depends on the presumption that the expert is not biased. But if this presumption is challenged, it needs to be supported by reasons. In order to explain how shifting of a burden of proof works, let's reconstruct an example from (Prakken; Reed & Walton 2004: 6).

Table II: Metadialogue Example of Shifting Burden of Proof

Moves of dialogue	Commitments	W Commitment store	B Commitment store
1. W: *claim* C	C	C	
2. B: *why* C	?C		?C
3. W: C *since* E says so and E is an expert about C	a. Posed: 1) E says that C, 2) E is expert about C b. Presupposed: 1) E is a reliable expert 2) If E says that C, C is plausibly true 3) E is presumptively not biased 4) What *E* asserted presumptively implies *A* 5) *E*'s assertion is presumptively based on evidence	a1 a2 b1 b2 b3 b4 **b5**	 b1 b2 b3 b4 **b5**
Metadialogue			
4. B: *why* ¬E biased	¬b1		No b1
5. W: *why* E biased	b1	b1	
6. B: BoP(¬E biased) *since* only experts proven to be unbiased can be trusted.	a3. The fact that only experts proven unbiased can be trusted implies that the burden of proof is on W b6. Only experts proven unb iased can be trusted	 b6	a3 b6
7. W: *why* only experts proven to be unbiased can be trusted?	¬b6 The proposition b6 taken for granted is not acceptable	No b6	
8. B: *why* ¬ only experts proven to be unbiased can be trusted?	?¬ b6 The refusal of b6 is not acceptable		No (no b6)
9. W: ¬ only experts proven to be unbiased can be trusted *since* experts may be presumed to be unbiased.	b5 → ¬ b6; b5 is a dialectical presumption	No b6	
10. B: *retract* only experts proven to be unbiased can be trusted.	Retraction (no b6)		No b6. retraction

In this example, the argument from expert opinion has a presupposed a missing premise necessary to the scheme. The metadialogue begins with challenging the presumption about the reliability of the expert. The dis-

cussion then turns into a dispute about the burden of proof. The type of common knowledge assumed in the missing premise cannot be challenged without providing reasons.

Implicit premises are propositions that are commonly known and therefore accepted by the interlocutors. For this reason, they do not bear any burden of proof for their proponent, because they are already granted, or presumed to be conceded by the hearer. Of course, they can be questioned, but if the presumption is based on common knowledge, questioning it represents a kind of detour from the dialogue onto matters of whether something can be taken for granted as common knowledge or not. In the meta-dialogue that begins with the challenge to a presupposition, the burden of proof sometimes remains on the proponent, while in other cases it shifts to the respondent. In the case above, it is interesting to notice that the challenge of implicit premises (or dark side commitments) proceeds until a dialogical presumption is reached. Black (B) attacks the implicit premise that the expert is presumptively reliable and a dialogue on the allocation of the burden proof begins. The discussion stops when Black does not refuse a dialogical principle, a commitment stemming from common knowledge of dialogical rules that he, in this particular context of dialogue, cannot reject.

4. Conclusions

We conclude that the notion of common knowledge central for the study of argumentation (as analyzed above) has more in common with the ancient view of it than the modern one. Many arguments based on common knowledge can secure tentative commitment, even though they are subject to critical questioning as a dialogue proceeds. Even so, we reject the claim that such arguments are inherently fallacious. The basis for their acceptance or rejection in individual cases is best judged in relation to the wider communication event of which they are a part. Common knowledge, on this view, is not knowledge, strictly speaking, but a kind of provisional acceptance of a proposition based on there being no need to dispute it, and its being generally accepted. In many cases, it is more accurate to say that such arguments are supported by premises that are generally accepted as knowledge of one sort or another. Sometimes it is scientific knowledge that is cited, or more often, opinions of experts in a domain of science that have been quoted or otherwise represented. Such presuppositions do not really represent knowledge at all, in the stricter

philosophical meanings of that term, but rather presumptions that are widely taken to be true or acceptable for various reasons.

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