

Argumentation Schemes and Burden of Proof

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Abstract. This paper analyzes the phenomenon of a shift of the burden of proof in persuasion dialogues in which arguments are constructed according to argumentation schemes. Some sample dialogues are analyzed with arguments from expert opinion, revealing that some critical questions of this scheme carry with them a burden of proof on the questioner while others do not, and that the burden of proof can become the subject of debate during a dialogue. Then these dialogues are diagrammed with the argument visualization software Araucaria, and a simple formal protocol is proposed of persuasion dialogues with embedded burden-of-proof dialogues.

1 INTRODUCTION

The objective of this paper is to analyze the phenomenon of a shift of the burden of proof in persuasion dialogues where arguments are constructed according to argumentation schemes. Suppose an argument instantiating some scheme has been put forward and a critical question matching the scheme for that argument has been asked. Does merely asking the question make the argument default, or is the burden on the questioner to provide evidence? In this paper we take the view that the answer to this question depends on domain-specific issues and that the domain context in which the dialogue takes place will often leave room for disagreement on allocations of the burden of proof. Accordingly, our aim is to present a protocol for two-person persuasion dialogues in which the burden of proof can become the issue under dispute. In developing our model, we will first analyze some sample dialogues using the argumentation scheme from expert opinion, then semiformal diagram these dialogues with the argument visualization software Araucaria [10], and finally present a formal protocol. The protocol will be simple, intended to give a first idea of how protocols for burden-of-proof dialogues can be formalized.

As for previous research, most dialogue systems for persuasion hardwire the burden of proof into the protocol. For example, [5] uses the following rule for distributing burden of proof at any local level in a dialogue: “whoever advances a standpoint is obliged to defend it if asked to do so”. This rule is also implicit in the dialogue systems of [6] and [12]. [1] were the first to model different levels of burden of proof for different assertions; see also [2]. [9] has proposed a protocol for three-party legal dialogues where a referee has the authority to distribute the burden of proof for specific assertions over the adversaries. To our knowledge, the present paper is the first to address the modelling of two-party persuasion dialogues about the burden of proof.

2 GLOBAL AND LOCAL BURDEN OF PROOF IN ARGUMENTATION IN DIALOGUES

In the general theory of argumentation in dialogue, burden of proof is important at the global level of a dialogue as well as at the local level. To consider how global burden of proof works in argumentation theory generally, the best kind of dialogue to begin with is the persuasion type. In the persuasion dialogue, there are two participants, called the proponent and the respondent. There are two subcases to be considered. In the *dispute*, the proponent has proposition a as her designated thesis. Her goal is to prove a , while the respondent’s goal is to prove the opposite (negation) of a . Thus each has a burden of proof. In the *dissent*, the proponent’s goal is to prove a , while the goal of the respondent is merely to show that the proponent’s attempt is not successful. In the dissent, the respondent’s goal is merely one of critical questioning rather proving. Thus in a dissent, the proponent has a burden of proof, but the respondent does not. In a dispute, it is clearer that each party has a burden of proof (or disproof). At any rate, each side will have what is called in law an ultimate *probandum*, which constitutes the parties’ global burden of proof. Thus at the global level, burden of proof pertains to a participant’s ultimate goal in a dialogue.

The global burden of proof is fixed during the entire dialogue. However, at the local level the burden of proof may change during a dialogue. Moves in which a proposition is asserted (either as a claim or as a premise of an argument) usually carry a burden with them to defend the assertion or else retract it when challenged. However, in exceptional cases the burden shifts to the other party to provide evidence that the proposition does not hold. This happens, for instance, in legal disputes when a legal presumption is invoked as a premise of an argument put forward to meet the global burden of proof. Then the local burden of proof with respect to the presumption shifts to the other party. For example, if in a civil case plaintiff provides evidence in the form of an affidavit, then according to Dutch civil procedure the content of the affidavit is presumed true unless the defendant proves it is false. So the local burden of proof with respect to the claim that the content of the affidavit is false is on the defendant.

In the law it is usually clear on the basis of procedural law when a shift in the burden of proof takes place (although even in the law this may become the subject of dispute; see [4] for a case study in Dutch civil law). However, in other contexts there may be no clear principles on the allocation of the burden of proof. In such contexts the dialogue may shift into a metalevel dialogue on who has the burden of proof. In the next sections we will analyze some dialogues where this takes place. To provide a focus for the investigation, we consider the example of the use of expert opinion evidence as form of argumentation, and especially with how and when the asking of critical questions shifts a burden or proof in response to an argument of this type. We also take as a starting point the diagramming capabilities of

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Araucaria, a piece of argument diagramming software that supports the diagramming of argumentation schemes.

3 DIALOGUES WITH ARGUMENTS FROM EXPERT OPINION

The argumentation scheme for argument from expert opinion is the following [11, p. 258]. In this scheme, *A* is a proposition, *E* is an expert, and *D* is a domain of knowledge.

Scheme for Argument from Expert Opinion

E is an expert in domain *D*

E asserts that *A* is known to be true

A is within *D*

Therefore, *A* may plausibly be taken to be true

The three premises in the scheme represent facts that are assumed to hold in a given case, in order to warrant drawing a reasonable inference to the conclusion. Argument from expert opinion is, however, a defeasible form of argument that holds on a presumptive basis, subject to the asking of appropriate critical questions by the other party in a dialogue. The respondent can ask any one of the following six critical questions [11, p. 25].

Critical Questions Matching Argument from Expert Opinion

1. *Expertise Question*: How credible (knowledgeable) is *E* as an expert source?
2. *Field Question*: Is *E* an expert in the field that *A* is in?
3. *Opinion Question*: What did *E* assert that implies *A*?
4. *Trustworthiness Question*: Is *E* personally reliable as a source, e.g. is *E* biased?
5. *Consistency Question*: Is *A* consistent with what other experts assert?
6. *Backup Evidence Question*: Is *E*'s assertion based on evidence?

A question of theoretical interest is whether these critical questions can be seen as implicit premises of an argument from expert opinion. Let's look at them, one at a time. 1: when you put forward an appeal to expert opinion, you assume, as part of the argument, that the source is credible, or has knowledge in some field. 2: you assume that the expert is an expert in the field of the claim made. 3: you assume that the expert said something, made some pronouncement, from which the claim can be extracted by inference, or in some cases, even by direct quoting. 6: you assume that the expert's assertion was based on some evidence within the field of his/her expertise. The argument doesn't make much sense without these assumptions being part of it. 4 and 5 seem to be a little different. If the expert turns out to be biased, or to be dishonest, then if there is evidence for such claims, that attacks the argument. But to mount such an attack, it looks like the critic should have to produce some fairly substantial evidence. If the claim can be shown not to be consistent with what other experts in the same field say, then that is an argument against the claim. But that needs to be shown by telling us what the other experts have in fact said, and showing how these statements conflict with what our expert said.

Our conjecture is that the difference is one of burden of proof. Critical questions 4 and 5 seem to have a positive burden of proof attached, while the remaining critical questions do not. Once asked, the

latter type of critical question must be given an appropriate answer or the original argument is refuted. Asking the other two is a harder task, if you want to get the question to get the original argument to default.

The same issue arises with critical subquestions [11] that fall under each of the six basic critical questions for argument from expert opinion. The following three critical subquestions [11, p. 217] come under the trustworthiness critical question.

Subquestion 1: Is *E* biased?

Subquestion 2: Is *E* honest?

Subquestion 3: Is *E* conscientious?

Suppose, for example, that the proponent has put forward an argument from expert opinion and the respondent asks if *E* is biased. Is this enough to defeat the proponent's argument, or in order to achieve that result, should the respondent have to offer some reason to think that the expert is biased? We think that in many cases merely asking the critical question is not enough and that the question should be combined with some evidence of the alleged bias. For example, the respondent might say something like, "This expert has something to gain by supporting this conclusion". This in turn suggests that the real value of having critical questions matching an argument is that the questions enable an arguer to seek out avenues that pinpoint points of challenge in an argument. These points of possible attack can then be followed up or not, depending on what is known or available as evidence in the case. Thus the value of the set of critical questions is that they provide an entry point for a further search into how to attack an argument, or to locate missing premises in it that can be questioned or at least recognized. In conclusion, some critical questions seem to shift a burden of proof, some do not. However, a further issue arises: is the fact that a particular critical question shifts a burden of proof context dependent or not? There is a Gricean default, perhaps (e.g. Expert Opinion - usually, there is presumption for the honesty of the expert), but it can be overridden by particular circumstances.

Perhaps some form of meta-dialogue can be used to determine the allocation of burden proof. According to this suggestion, the *protocol* should prevent the infinite regress past 'Why *A*?; why not *A*?', by recognizing that the argument has shifted to an embedded persuasion dialogue on who has the burden of proof. Individual agents will have defaults covering application of burden of proof rules. Discrepancies in these rules, or unilateral belief in exceptions to agreed-upon, common rules, could both give rise to embedded burden of proof meta-dialogues.

We now pass on to the question of how asking questions or offering challenges commits a player to a particular view on the burden of proof (see [3, pp. 268-273] for a discussion of commitments that can be incurred by challenges). Consider a sample dialogue (In the dialogues that follow, two participants *W* (White) and *B* (Black) takes turns making moves, where each move is numbered in the sequence on the left.):

- W*₁: *C* since *E* says that *C* (Argument from Expert Opinion)
*B*₂: Is *E* biased? (CQ *P*₁?)
*W*₃: You think he is biased? (not *P*₁?)
*B*₄: Er, no.

At *B*₂, *B* takes on a propositional commitment to the effect that *W* has the burden of proof with respect to *P*₁. At the next step, *W* takes on a commitment that it is *B* that has the burden of proof with respect to *P*₁. The locution *B*₄ simply concedes and thus stops any opportunity for a burden of proof dialogue. An alternative completion is

$B_{4'}$:

$B_{4'}$: Yes, because E has an investment in C

So again, there is no disagreement about the burden of proof, but this time, B substantiates his challenge.

But one further possible completion is $B_{4''}$:

$B_{4''}$: Isn't it for you to show that he's not?

This is an explicit move to a burden of proof type dialogue, in which the topic of the discussion is the issue of who has the burden of proof with respect to P_1 .

We don't want every critical question to introduce a burden of proof meta-dialogue. So another question arises. Do all challenges and answers commit players to views on burden of proof? Consider this dialogue (the expression "add_commitment($B, BoP(W, R)$)" means that B has incurred a commitment to the proposition that W has the burden of proving the proposition R).

W_1 : R

B_2 : R ? add_commitment($B, BoP(W, R)$)

W_3 : R since P add_commitment($W, BoP(W, R)$)

At W_3 , W can alternatively reject B 's commitment at B_2 , with

$W_{3'}$: not- R ? add_commitment($W, BoP(B, not-R)$)

or alternatively,

$W_{3''}$: I don't have to prove R no_commitment($W, BoP(W, R)$)

These two may or may not be equivalent. But $W_{3'}$ seems stronger than $W_{3''}$ as it places a burden of proof on the respondent.

4 DIAGRAMMING BURDEN-OF-PROOF DIALOGUES

As illustrated in the previous section, even very simple dialogues can involve analyses that appear textually to be very complex, even though the rules, system, process and resulting structures of those analyses are actually very simple. What is required is a better way of presenting those analyses. *Araucaria* [10] supports the generation of easy-to-interpret diagrams charting the progress of a dialogue. As an example, consider the following surface text of a dialogue:

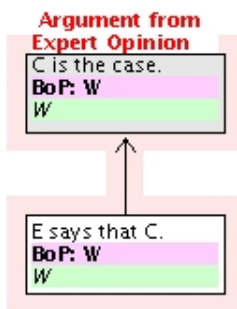
W_1 : C since E says that C

B_2 : Is E biased?

W_3 : You think he is biased?

B_4 : Er, no.

At (1), W sets out the following argument:



The W at the bottom of a box indicates that it was W who asserted the proposition at the top of the box. The BoP line in a box indicates which participant is currently responsible for burden of proof with

respect to the claim. Let us examine B 's first response. With (2), B does not claim that E is, in fact, biased - even implicitly. What B does is to challenge the nature of the presumption. By using the argumentation scheme at (1), W is implicitly claiming that B has the burden of proof with respect to any challenge. By asking the question at (2) B is doing one of two possible things. One alternative is that he is opening up a challenge (with a particular rhetorical gambit) for which he has proof and can accept the burden. The other is that he has no such proof, and is instead trying to shift the burden of proof to W . At the completion of (2), there is thus an ambiguity: W is unable to know whether B is accepting the burden of proof with respect to E 's bias, and is thereby throwing down a real gauntlet, or whether in fact, B is 'trying his luck' - attempting an illicit shift of the burden of proof. In this example, at (3) W risks, rhetorically, opening herself to the supported challenge that B might be able to make, for the sake of forcing adherence to the specification of the argumentation scheme she has used that lays down that the burden of proof with respect to bias lays with the challenger. Thus W is assuming that B is, in fact, following the second course of action, and is trying to shift the burden of proof illicitly. In response, W challenges B 's claim that W has the burden of proof, and, furthermore, asserts that B himself has the burden of proof. Finally, at (4), B accepts the burden of proof for the bias claim, and then, in addition, backs down and concedes that he has no proof.

It is thus as though in our dialogue there is an entire separate, implicit dialogue being conducted concurrently about the burden of proof. Schematically:

Explicit Dialogue

Implicit BoP dialogue

C since E says that C (x since y)

Is E biased? (P_1)?

You think he is biased? ($\neg P_1$)?

Er, no. ($\neg P_1$).

$BoP(W, x), BoP(W, y)$

$BoP(W, P_1)$

$BoP(W, P_1), BoP(B, P_1)$

$BoP(B, P_1)$

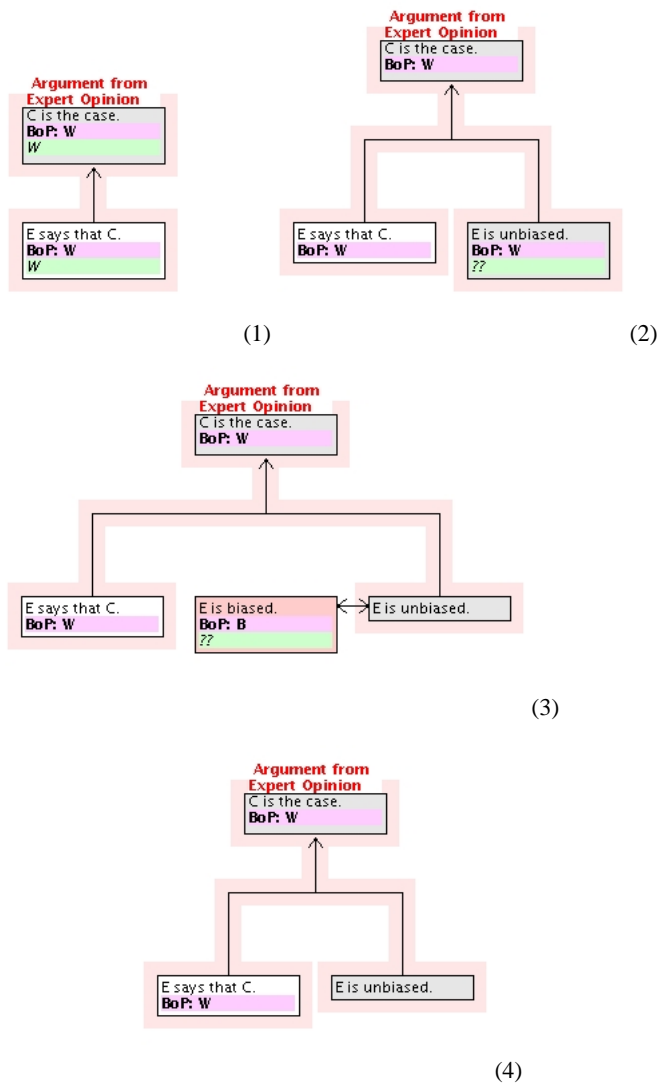
The statements in both the explicit dialogue and the implicit BoP dialogue have effects on the commitment stores of the players, as usual. But in addition, the commitments to BoP have implications for what is allowed in the explicit dialogue. For example, if a player is committed to the claim that she has BoP with respect to a proposition P then be challenged over P obliges her to provide a defence.

How then, might such structures be diagrammed? Let us separate four components:

- (i) dialogue
- (ii) interrogatives
- (iii) retractions
- (iv) burden of proof

For the first component, diagramming dialogue is the topic of current research for the *Araucaria* project. For now, we adopt the 'flipbook' approach above of showing snapshots of the dialogue at each turn. For interrogatives, we adopt a simple, pragmatic convention whereby the questioned premise is marked by "??". Retractions cannot easily be accommodated without complicating the diagrammatic notation. The 'flipbook' approach means that retractions can simply be removed from the diagram at the appropriate step, with the record of its existence occurring on an earlier 'page'. Lastly, diagramming burden of proof is accomplished by marking each proposition by the names of all those who are claimed to have burden of proof for it.

So, the diagram for the dialogue above is as follows:



One interesting thing is that in *Araucaria* a natural way to diagram W 's move in (3) is to focus on the counter-position, and demand that B take on Burden of Proof with respect to that counter-position (which, of course, W then questions, as indicated by the ?? mark). In other words, it is helpful to distinguish between the sign, or sense, of the proposition when allocating burden of proof. This fits well with intuition - consider the extension in which the BoP dialogue is made explicit: "It's not for me to show that he's not biased, but rather, for you to show that he is!" - an intuitive and common phrasing that emphasizes, in both semantics and prosody, the sign of the proposition.

Diagramming thus helps to interpret and assimilate an analysis (and, in future, to conduct the analysis), but it is not sufficient to develop an account of burden of proof in scheme-rich dialogue that has explanatory power. For that, a formal model is required, and it is to such a model that we turn next.

5 A SIMPLE PROTOCOL FOR TWO-PARTY BURDEN-OF-PROOF DIALOGUES

We now formalize a protocol for the embedding of burden-of-proof (BoP) dialogues in 'conventional' persuasion dialogues of the dissent type. The aim of this is to give an idea of one possible way in which the considerations of the previous section could be formalized.

In order to focus on the essence, we keep the protocol as simple as possible. Each dialogue starts with claiming a certain proposition p , where p is a propositional formula. The claim can be conceded (*concede p*) or challenged (*why p*). A challenge can be replied to with an argument p since Q where Q is a set of propositional formulas and the argument instantiates one of a set of predefined argumentation schemes. The set Q contains the argument's premises. Each argument also has a set A of assumptions, which consists of positive answers to the critical questions of the scheme it instantiates and that are not among its premises. Arguments can be responded to by challenging or conceding any of its premises or assumptions or by conceding its conclusion. Challenges can be responded to by retracting the challenged proposition (*retract p*), by giving an argument for it (p since Q), or by giving an argument why the other party has the burden of proof for the opposite ($BoP(-p)$ since R). Such a BoP argument can be responded to as any other argument. We formulate the protocol as an instance of the framework of [8], though other styles of formulation may be possible.

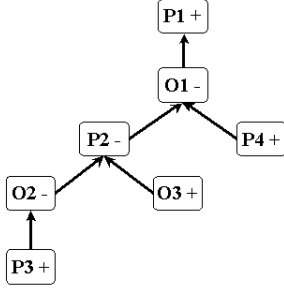
5.1 OUTLINE OF A FRAMEWORK FOR PERSUASION DIALOGUES

The framework of [8] is based on the following ideas. Each dialogue move except the initial one replies to one earlier move in the dialogue of the other party (its *target*). Thus a dialogue can be regarded in two ways: as a sequence (reflecting the order in which the moves are made) and as a tree (reflecting the reply relations between the moves). Each replying move is either an *attacker* or a *surrender*. For each possible speech act the sets of all its surrenders and attackers must be defined. For instance, a *why p* move can be attacked with a p since Q move and surrendered with a *retract p* move. The protocol is flexible in that it allows for alternative replies to moves (needed since, for instance, most argumentation schemes have more than one premise and critical question) and for postponement of replies (sometimes indefinitely). This flexibility is realized through the notions of relevance and dialogical status of moves.

The *dialogical status* of a move is recursively defined in terms of the nature of its replies. A move is *in* iff it is surrendered or else if all its attacking replies are out. (This implies that a move without replies is in). And a move is *out* if it has a reply that is in. Furthermore, a move is *definitely in (out)* if it is in (out) and its status cannot change any more. With this concept of dialogical status a notion of relevance can be defined. A move is *relevant* if it replies to a relevant target. And a move is a *relevant target* if making it out changes the dialogical status of the initial move of the dialogue. These definitions imply that a move is a relevant target for proponent (opponent) if making it out makes the initial move in (out).

Actually, this has to be refined to allow that some premises or assumptions of an argument are conceded while others are challenged. Accordingly, all moves have *components*. For moves other than *since* this is just the move itself but the components of *since* moves are all its premises and its conclusion. The notions of dialogical status and relevance are relativized to move components, and a move is defined as in if all its components are in and as out otherwise.

The picture below (with only attacking replies) illustrates the notion of relevance. A move labelled + is in and a move labelled - is out. P_3 is not a relevant target for O : although making P_3 out makes O_2 in, P_2 was already out because of O_3 and therefore O_1 stays out because of P_4 , so that P_1 stays in. However, P_4 is a relevant target for O : making P_4 out makes O_1 in since its only attacking reply is now out; then P_1 is out since it now has an attacking reply that is in.



Now the main rule of a protocol fitting the framework of [8] is that a move is legal if it is relevant (and satisfies the other protocol rules). Consequently, a *turn* of a player (that is, a maximal sequence of legal moves by the same player) always consists of zero or more surrenders followed by a single attack. Accordingly, *turntaking* is defined as the situation where the dialogical status of the initial move has been changed. These definitions imply that the turn shifts to the opponent if the initial move is made in while it shifts to the proponent if the initial move is made out. Finally, a dialogue *terminates* if a player is to move but has no legal moves. It follows that this only happens if the status of the initial move is *against* the player to move (out for the proponent and in for the opponent). So if a dialogue terminates when player p is to move, p can be said to have *lost* the dialogue.

To summarise the main ‘structural’ rules of the framework of [8]:

1. Each replying move must be defined as an attacker or a surrender of its target.
2. Alternative replies to the same target must be different.
3. Each move must be relevant.

These rules are the minimal conditions for legality of a move. In addition, it is possible to define further legality conditions, such as the usual rules for respecting the player’s commitments (see e.g. [12] or rules preventing circular dialogues (see e.g. [6]).

However, to keep the protocol simple, we will only add rules that are essential for regulating the embedding of BoP subdialogues in a persuasion dialogue. Our main tasks then are to define these extra rules and to define the set of possible moves with their replies.

5.2 A PROTOCOL FOR BoP DIALOGUES

According to [12, p. 149] a protocol for dialogue has four elements: the *locution rules* (which moves are possible in principle), the *structural rules* (which moves are allowed at a given moment), the *commitment rules* (what are the propositional commitments of the players at each stage) and the *termination rules*. As just explained, we leave the commitment rules unspecified for simplicity. Our termination rule is the one of [8]: a dialogue terminates if a player is to move but has no legal moves. The locutions of the protocol are displayed in the following table.

Acts	Attacks	Surrenders
<i>claim p</i>	<i>why p</i>	<i>concede p</i>
<i>p since_AQ</i>	<i>why q_i (q_i ∈ Q ∪ A)</i>	<i>concede q_i (q_i ∈ Q ∪ A), concede p</i>
<i>why p</i>	<i>p since_AQ, why -p, BoP(-p) since_AR</i>	<i>retract p</i>
<i>concede p</i>		
<i>retract p</i>		

An additional constraint on *p since_AQ* moves is that they must instantiate some predefined argumentation scheme (the subscript A denotes the assumptions of the argument; note that these are left implicit when an argument is stated; therefore the subscript will below be omitted). As for notation, $\neg p$ denotes the contrary of p : the contrary of p is $\neg p$ and the contrary of $\neg p$ is p (where \neg is classical negation). Formulas of the form *BoP(p)* are regarded as propositional atoms with some syntactic sugar so that a *BoP(p) since Q* move can be replied to as any other *since* move.

As for the structural rules, they include rules (1-3) above. What remains is to regulate the embedding of BoP dialogues in other dialogues (possibly also BoP dialogues). First we add a rule that a *why* move must be the first reply to its target. This avoids situations where first another *why* move is replied to with a *since* move and then a *why* reply is moved. Next, in order to ensure orderly and well-structured dialogues, we want that each BoP dialogue is completed before a participant may jump back to a surrounding dialogue. This can be achieved by assigning to each move a dialogue level and to require that a target of a move is of the highest possible level. (Below we say that a level l is higher than a level l' if $l > l'$; $<$, $=$ and \neq are defined as usual for natural numbers). The level of a move in a dialogue M_1, \dots, M_n is defined as follows:

- $\text{level}(M_1) = 1$
- $\text{level}(M_{i+1}) =$
 - $1 + \text{level}(\text{target}(M_{i+1}))$ if M_{i+1} is a *BoP(p) since Q* reply to a *why -p* move;
 - $\text{level}(\text{target}(M_{i+1}))$ otherwise.

Now we add to the above structural rules (1-3) a fourth and fifth rule:

4. If M is a *why* move replying to a move component M' , then M' has not yet been replied to.
5. If M is legal then there is no $M' \neq M$ that satisfies structural rules (1-4) and such that $\text{level}(\text{target}(M)) < \text{level}(\text{target}(M'))$.

Taken together, our structural and locution rules imply that a jump back to a lower level is legal only if the current BoP dialogue is ‘terminated’, that is if the move that started the current BoP dialogue has obtained a definitive status. To see this, observe that otherwise there are still legal moves that can change its status and so by (5) no reply to a higher-level target is legal. Also, our protocol implies that a jump to a lower level that is not equal to level 1 will always be to the immediately preceding surrounding dialogue. To illustrate this with an example, suppose that a dialogue starts with a sequence M_1, \dots, M_3 at level 1, then jumps to level 2 at M_4, \dots, M_9 , then jumps back to level 1 at M_{10}, \dots, M_{17} , then jumps to level 2 at M_{18}, \dots, M_{23} , and jumps higher to level 3 at M_{24}, \dots, M_{27} . Our protocol implies that the BoP subdialogue M_4, \dots, M_9 is ‘terminated’ at M_9 by making M_4 definitely in or out, so it contains no relevant targets for subsequent moves. This implies that if M_{24}, \dots, M_{27} ‘terminates’ at M_{27} , then the only relevant targets for M_{28} that are of level 2 are in M_{18}, \dots, M_{23} . Note, however, that this phenomenon does not hold for moves that jump back to level 1: suppose that M_{28}, \dots, M_{32} continues M_{18}, \dots, M_{23} at level 2 and M_{33} ‘terminates’ this BoP dialogue; then M_{34} may reply to any level-1-move in the dialogue that is a relevant target, even to M_1 (by conceding or retracting its claim), since the level-1-dialogue is not terminated until the claim of M_1 is conceded or retracted.

5.3 AN EXAMPLE DIALOGUE

In this section we illustrate the protocol with an example dialogue. The target of a move is given between square brackets. To the right of each move the dialogical status of some moves of interest is listed.

- W_1 : *claim C*
- W_1 is in
- B_1 [W_1]: *why C*
- W_1 is out, B_1 is in
- W_2 [B_1]: *C since E says so and E is an expert about C*
- W_1 is in
- B_2 [W_2]: *why E says so*
- W_1 is out
- W_3 [B_2]: *E says so since this is apparent from this transcript*
- W_1 is in, B_1 is out
- B_3 [W_2]: *concede E says so*
- W_1 and W_2 are in, B_1 remains out
- B_4 [W_2]: *why $\neg E$ biased*
- W_2 and W_1 are out
- W_4 [B_4]: *why E biased*
- W_1 is in, B_4 is out
- B_5 [W_4]: *BoP($\neg E$ biased) since only experts proven to be unbiased can be trusted.*
- W_4 and W_1 are out, B_3 is in
- W_5 [B_5]: *why only experts proven to be unbiased can be trusted.*
- B_5 is out, W_1 is in
- B_6 [W_5]: *why \neg only experts proven to be unbiased can be trusted.*
- W_5 is out, B_5 is in, W_1 is out
- W_6 [B_6]: *\neg only experts proven to be unbiased can be trusted since experts may be presumed to be unbiased.*
- B_4 and B_5 are out, W_1 is in
- B_7 [W_6]: *concede experts may be presumed to be unbiased.*
- B_4 and B_5 remain out, W_1 is in
- B_8 [W_5]: *retract only experts proven to be unbiased can be trusted.*
- B_5 is definitively out, W_1 is in
- B_9 [W_4]: *E is biased since his previous research was paid by the company he testifies for.*
- W_4 and W_1 are out, B_4 is in
- W_8 [B_8]: *concede E is biased*
- B_7 is in, W_2 and W_1 remain out
- W_9 [B_1]: *retract C*
- W_1 is definitively out

At this point W remains to move but has no legal moves any more since W_1 is definitively out, so the dialogue terminates with a loss for W . Apparently, the proponent could not find another argument for his claim C and therefore retracted it. As for the levels of this dialogue, at B_5 the dialogue jumps from level 1 to level 2. Consequently, after B_5 no replies to moves before B_5 are allowed until the level-2 dialogue is 'terminated'. This happens at B_8 , when B retracts the only premise of his burden-of-proof argument, thus making B_5 definitively out so that no reply to any level-2 can change the status of W_1 anymore. In other words, after B_8 the dialogue jumps back to level 1 so that new replies to moves before B_5 are allowed. This explains why B can reply at B_9 to W_4 .

6 CONCLUSION

We began this paper by asking whether merely asking a critical question attached to an argumentation scheme is sufficient to make the argument default, or whether the burden is on the questioner to provide evidence. By analyzing some dialogues we saw that this may

be different for different critical questions of a scheme. Some critical questions reveal an implicit premise for which the party who puts forward the argumentation scheme generally has the burden of proof. But other critical questions challenge something that may generally be presumed by the party who uses the argumentation scheme. We concluded that protocols for persuasion dialogues with argumentation schemes must be able to handle this difference. Moreover, we saw that the general principles on what may be presumed can be overridden in special cases so that the burden of proof can itself become the subject of dispute. To respect these two observations, we proposed a simple formal protocol for persuasion dialogues with embedded burden-of-proof dialogues. We also discussed a possible way to diagram such dialogues within the *Araucaria* software system.

Our proposed protocol is still simple and must be extended in various ways. For instance, commitment rules should be added in order to handle implicit BoP-dialogues such as displayed in Section 4. Also, the formalization of similar protocols should be investigated in dialogue frameworks other than that of [8], and the relation with [7]'s work on combining dialogue protocols is worth investigating. As for argument diagramming, both dialogue and burden of proof introduce complexities that threaten to swamp the diagrams with detail that would tend to obfuscate the main purpose of using such a diagram. Dealing with this challenge forms a key component of our planned research. Extending this research to the study of burden of proof persuasion dialogue generally is a direction that needs to be taken. This direction will turn out to be of vitally important practical utility, both in theoretical development and in tools for supporting real world argumentation.

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