Representing Dialectical Arguments

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Abstract

The purpose of this paper is to present and contrast two approaches to representing the structure of complex, dialectical arguments. Previous research has focused mainly on representing single arguments presented by a single arguer; this analysis examines the naturalistic give and take of dialectical argumentation among fourth graders. One approach to representing dialectical arguments is the argument network approach, which views the arguments as webs of interlocking premises and conclusions. The second approach is the causal network approach, which treats many of the ideas presented in the discussions as events linked in causal, narrative sequences. The two approaches capture different but complementary aspects of the structure of the arguments.

In a formal debate or in a spirited disagreement among friends, how can the structure of the interwoven arguments and counterarguments be represented? The study of argument structure has an ancient history among philosophers and rhetoricians, but these scholars have usually focused upon arguments made by a single arguer. This paper, by contrast, investigates the structure of complex dialectical arguments, in which two or more participants present arguments for different positions and responsively attempt to counter each others' arguments.

The purpose of this paper is to present and contrast two approaches to mapping the structure of complex, dialectical arguments. One approach is the *argument network* approach; the other is the *causal network* approach. The two approaches provide complementary views of dialectical arguments. Each is potentially a useful tool for evaluating the quality of argumentation and for tracing the development of dialectical argumentation among students.

Data and analyses

The argument network and causal network approaches to representing dialectical discussions were developed through analyses of 20 discussions held in four fourth-grade classrooms. In each discussion, the children informally debated an issue raised by a story they had just read. For instance, in one of the stories, "Stone Fox," set in frontier Wyoming, a boy named Willie and his grandfather are about to lose their farm because the grandfather has been too sick to work and so has fallen behind on mortgage payments. In a desperate attempt to save the farm, Willie enters a local dogsled race. His most formidable competitor is Stone Fox, a Native American who regularly wins on the dogsled race circuit and uses the money to buy back tribal lands taken by white settlers. Despite having just one dog, Willie is about to win the race when his dog dies. Stone Fox is close behind and soon catches up. The other racers are far behind. At this point, the students stop reading and discuss the question, "Should Stone Fox let Willie win the race?"

The 20 discussions took place in 10 reading groups in four classrooms. The groups ranged in size from 5 to 10 students, and the discussions ranged in length from 17 to 28 minutes. Five different stories were used; most discussions centered around ethical issues raised by these stories. Each discussion was led by the students' usual classroom teacher.

To illustrate the two approaches to representing dialectical arguments, I will present detailed analyses of the following transcript, which is taken from the very beginning of one group's discussion after reading the story "Stone Fox."

1 **Carl** I think Stone Fox should go ahead and win because, well I mean, Willie's dog is dead. And I mean, well, he can't bring the dog back to life and have the dog go ahead.

2 **Marla** Carl, Carl, just--this story made me think of my dog and we had to get rid of my dog. . . . Wouldn't you, pretend you are little Willie, and you are almost ready to win a race and save your grandfather's land and you are 10 feet away, just 10 feet away, and then your dog dies. Wouldn't you be very upset? I would, I mean, I would have just sat there. I wouldn't have done anything. I think they should just make it a tie and they can split it and Willie's grandfather can try and pay the rest of it since he got better all of a sudden.

3 **Carl** But, Marla, what if you were Stone Fox and the opponent that you knew you had to beat, their dog died and you knew they died, it's not like you can bring them back to life and let them win.

4 **Marla** Yeah, but still, if I were Stone Fox, I would feel sorry for a kid who had a dog practically killed, I mean, I mean the kid practically won and he only had one dog.

5 **Alan** Yeah, but he could just win the race and maybe give one of his dogs uh to uh Willie. And uh if uh you were Willie and you just had a dog die, what would you rather have, the dog or the money?

6 **Marla** I would--but Carl, you see if Stone Fox could win and he could get um but--just think if your dog died and the tax collector was right there and if he saw how close you were for paying off your taxes, I think the tax collector would give you a little bit more time to earn the money. And he could split it with (Willie).

7 **Carl** But Stone Fox also had land. He also needed the money for his land, too//

8 **several** Yeah

9 **Carl** And it said in the story, that um somewhere in here, that when they were going past the . . . when they were going past the . . . um . . . their grandfather's place, the farm um . . . it said that the grandfather was fine. He was//

10 **Marla** It did not say he was fine, it said he was better.

11 **Carl** Yeah.

12 **Marla** No, it doesn't mean like he's perfectly fine. That morning he was very sick, that last night, he had to get his medicine. I mean, if you had the chicken pox, you could get better and everything, but you couldn't get better overnight.

13 **Carl** He was sick for a long time.

14 **Marla** Yeah, he was also, they said that the night before the race that Willie had to go out and get his grandfather's medicine, he ran out of medicine.

15 **Carl** Yeah, he ran out of medicine.

16 **Marla** Yeah, but, doesn't that hint that he is not that well yet?

17 **Carl** Even though I'm not sick any more, I still take medicine.

18 **Marla** Yeah, that's so to prevent//

Argument Networks

In recent decades, researchers in a variety of fields have used simple schemas or frames to represent the structure of single arguments. These researchers often stress that arguments are not deductively valid but are instead plausible yet defeasible. The most widely used approach to representing plausible arguments is typified by the argument frame advanced by Toulmin (1958), illustrated in Figure 1.

Toulmin's argument frame has six elements. The claim (C) is the conclusion of the argument. The claim is supported by a premise, called a datum (D). The datum is linked to the claim by the warrant (W), which essentially allows one to infer the claim from the datum by *modus ponens*. The warrant is usually left unstated in real arguments (see Toulmin, 1958; van Eemeren & Grootendorst, 1992), but even when it is left unstated, it is frequently supported by an explicitly stated backing (B). The argument may be qualified by an adverb such as *presumably* or *probably* (Q). Conditions under which the argument do not apply are indicated by a rebuttal (R).

Argument frames similar to Toulmin's have been adopted by scholars in numerous fields, including rhetoric (e.g., Fisher, 1988), philosophy (e.g., Scriven, 1976), artificial intelligence (e.g., Cavalli-Sforza, Lesgold, & Weiner, 1992; Cohen, 1985), law (Wigmore, 1937), linguistics (e.g., van Eemeren & Grootendorst, 1992), education (e.g., Russell, 1988), and psychology (e.g., Voss et al., 1986). Most of these researchers have focused on relatively simple arguments made by single individuals. By contrast, there is little work on how to represent the ideas presented in the give and take of complex, dialectical arguments (although see Cavalli-Sforza et al., 1992; Wigmore, 1937).

The argument network approach to representing dialectical arguments is based on Toulmin's argument frame. The argument frame is modified in several ways to represent dialectical arguments rather than simple arguments presented by a single arguer. Argument frames must be allowed to link with each other, so that there is a gradually expanding web of interlocking arguments. In order for the argument frames to be interlinked, the basic argument frame is simplified. First, backings are not treated as a separate element within each argument frame. Instead, a backing is simply a datum whose claim is the warrant from a different argument frame; backings and warrants therefore have the same relationship as any other datum and claim. Second, rebuttals are treated not as separate argument elements but as data that contradict claims, warrants, or other data. Third, data are sometimes conjunctive, so that several propositions taken together can serve as the datum supporting a claim. These modifications permit one to combine argument frames in a straightforward manner to produce webs of interlinked arguments and counterarguments. Figure 2 presents an argument network for the beginning of the Stone Fox discussion. (Each statement is numbered with its turn number.)

Three ultimate claims are argued for. Carl argues that Stone Fox should go ahead and win the race, and he supports

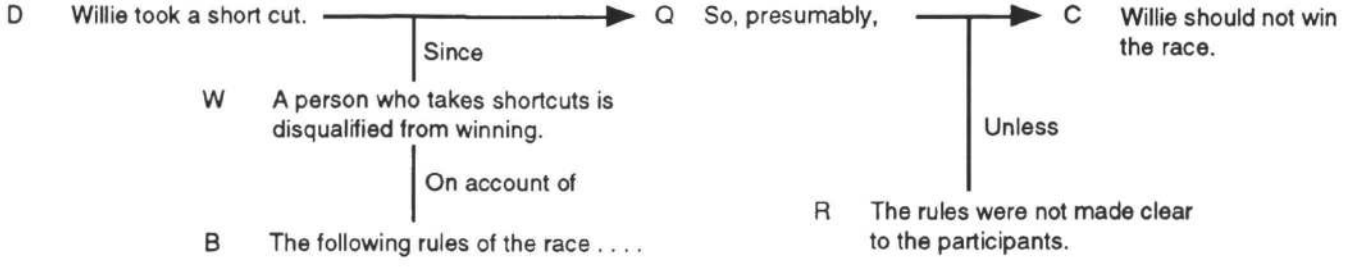

Figure 1. Example of Toulmin's argument frame.

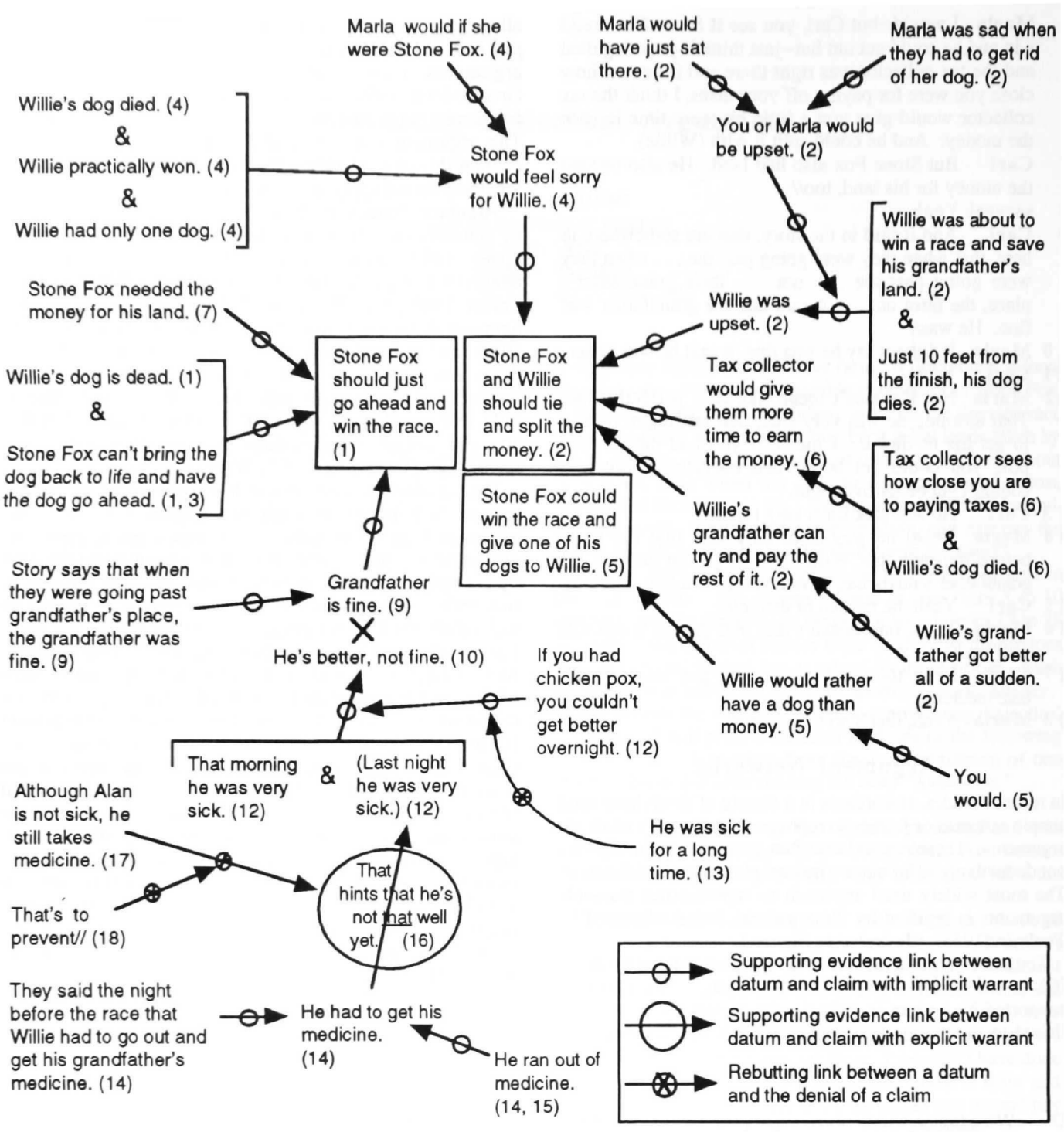

Figure 2. An argument network representation of a segment of a dialectical argument.

his claim with three separate lines of argument in Turns 1, 3, 7, and 9. Marla argues in Turns 2, 4, and 6 that Stone Fox should tie with Willie and split the money with him. Alan claims in turn 5 that Stone Fox should give Willie one of his dogs. In Turns 9 through 18, Marla and Carl construct an argument around the claim that Willie's grandfather is now better, with Carl arguing that grandfather is better and Marla that he is still sick.

Even though the argument network in Figure 2 represents only a small portion of one discussion, it illustrates several features that are typical of all the discussions in the corpus. First, the students broach many lines of argument, yet most of these lines of argument are not taken up by other students and so are left undeveloped. For instance, in Turn 7 Carl points out that one reason why Stone Fox should win is that Stone Fox needs money for his land, but other students do not pick up on this point, so the idea goes unelaborated

and unchallenged. Only a small proportion of arguments are extensively elaborated. Second, most lines of argument are constructed by a single individual; this is especially true of the less-developed arguments. A smaller percentage of arguments are developed by multiple participants, and these arguments are usually the most highly developed ones. Third, students explicitly state very few warrants (3% of all warrants in the fully analyzed discussions), but there is a much larger proportion of implicit warrants that are supported or rebutted with additional, explicitly stated data. For instance, in Figure 2 there is just one explicit warrant, but there are four implicit warrants that are explicitly backed or rebutted.

Thus, the argument network representation provides a powerful tool for analyzing the development of dialectical argumentation in children. The representation makes it easy to count such features as the number of lines of argument and the relative degree of development of different lines of argument.

Causal Networks

An alternative approach to mapping dialectical arguments is the causal network. The causal network approach is inspired by work by Trabasso, van den Broek, and their colleagues (e.g., Trabasso & van den Broek, 1985) on the causal structure of stories. The causal network approach is also related to work by Pennington and Hastie (e.g., 1992), who have demonstrated that people who observe a criminal trial organize what they learn in the trial as narratives. Figure 3 presents a causal network for the dialectical argumentation in Turns 1 through 4 of the transcript. (Each node is numbered with turn numbers. Rectangles indicate events that actually occurred in the story. Ovals mark hypothetical events that could happen to story characters in the future. Trapezoids mark ideas derived from background knowledge.)

Causal network representations of dialectical arguments appear necessary because argument networks fail to capture two key characteristics of the argumentation. First, argument networks fail to capture causal and temporal connections. For instance, Marla's first contribution to the discussion in Turn 2 includes the following propositions: (a) Willie was about to win the race, (b) Willie's dog died, (c) Stone Fox would feel sorry for Willie, and (d) Stone Fox could tie and split the money with Willie. In the argument network representation, these four propositions are separate claims and data in separate arguments. They possess no temporal relationships, because the argument frames allow only the relationship of premise and conclusion. But in fact, the four assertions make up a temporal sequence of events, with each event enabling or causing the subsequent event. Marla's argument, therefore, is not just a set of premises and conclusions but a series of events that are connected causally and temporally. The ordering of these propositions in the argument network in Figure 2 does not reflect this temporal order or causal connection.

It is possible, of course, to augment argument networks with formalisms that encode causal and temporal relations. This has not, however, been done by most of the scholars who have used argument frames. More important, the core organizing principle of argument networks is the premise-conclusion relationship rather than the causal or temporal relationship. In the argument network, the most closely related ideas are seen to be ideas that fall into premise-conclusion patterns rather than ideas that are temporally or causally related. In the causal network, precedence is given to the causal and temporal relationships.

The second shortcoming of argument networks is that they sometimes dissociate ideas that appear to be closely connected. To illustrate, in the argument network in Figure 2, Carl's first argument (Stone Fox should win because Willie's dog is dead and can't be brought back to life) is not linked to Marla's argument that Stone Fox would feel sorry for Willie, so Stone Fox should let Willie tie); instead, Figure 2 implies that Carl makes one argument, and Marla makes a separate argument for a contrary position. However, Carl and Marla's arguments actually seem to be more closely connected: Both are concerned with the ramifications of the death of Willie's dog. Carl insists that the dog's death means that Willie can't win, so Stone Fox might as well go ahead and win. Marla, by contrast, focuses on a different set of consequences of the dog's death. Willie's misfortunes would lead Stone Fox to feel sorry for him, so Stone Fox might decide to tie with Willie. The argument network representation fails to highlight this focus on alternative consequences of the dog's death.

In causal network representations of dialectical argumentation, events are placed in causal, temporal sequences. The events form causal sequences in which one event may strongly cause or weakly enable the next event in the sequence (Trabasso & van den Broek, 1985).

In causal network representations of dialectical arguments, *envisionments* (de Kleer & Brown, 1984) play a key role. Envisionments are mutually exclusive alternative causal paths. De Kleer and Brown applied the idea to the domain of physical causality, but envisionments can also be applied to ethical argumentation. The dialectical arguments in our corpus often consist of students proposing different hypothetical envisionments that could follow from particular events. For instance, Stone Fox could decide to let Willie tie him, which would have one set of likely consequences, or he could go ahead and win, which would have a mutually exclusive set of likely consequences. Students' arguments often center around just what these likely consequences are.

Figure 3 is a causal network of the first four turns. Carl begins in Turn 1 by laying out two envisionments that could ensue from the dog's death: Stone Fox could go ahead and win the race, or the dog could come back to life and go ahead. Because the latter envisionment is physically impossible, Stone Fox is left with no alternative but to go ahead and win the race.

The nodes labeled *2a* in Figure 3 make up the first part of Marla's response to Carl in Turn 2. The causal network representation, unlike the argument network representation, shows that Marla is building upon the ideas that Carl has introduced. She begins by adding three events that precede the state of Willie's dog being dead These antecedents are that Willie is 10 feet from the finish line, Willie is about to win, and then the dog dies. Then Marla adds further consequences to what would have happened if Willie had won:

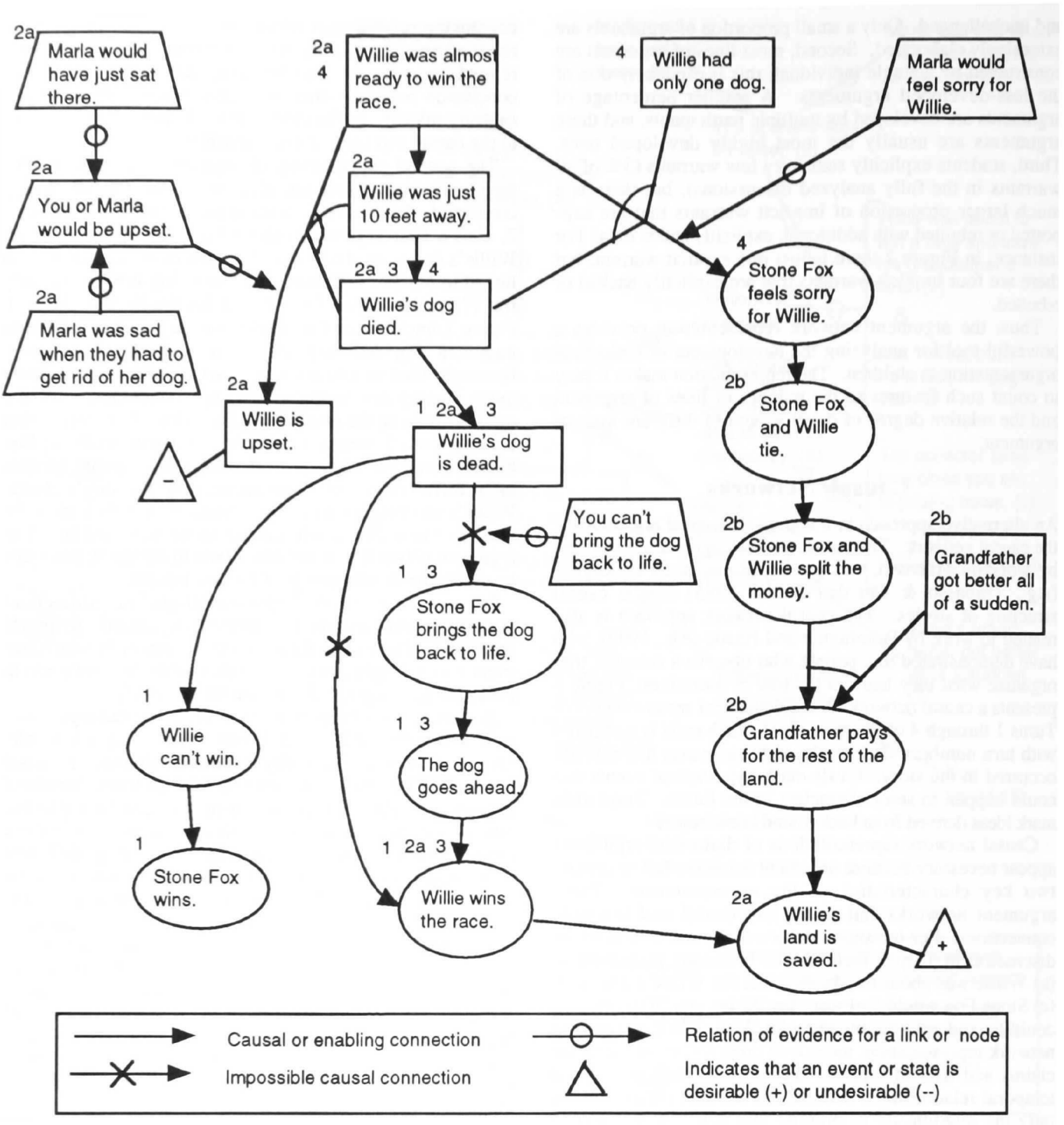

Figure 3. A causal network representation of a segment of a dialectical argument.

Willie would have won the race and saved his grandfather's land. Marla has thus built upon the beginning and end of one of Carl's causal chains.

Marla also notes a new consequence that follows from the dog's death: The dog's death upsets Willie. Marla's clearly implies that this state is highly undesirable, which is symbolized in the network by a triangle with a minus sign inside it.

In the last half of Turn 2 (the nodes labeled *2b* in Figure 3), Marla constructs a new envisionment that achieves the desirable state of Willie's land being saved. Marla proposes that Stone Fox and Willie tie and split the money. Then, since Willie's grandfather is getting better, he will be able to pay for the rest of the land and save the farm.

Each of Marla's envisionments culminates in one or more state or event that is taken to be desirable or undesirable. This is typical of the children's ethical argumentation in our

corpus of discussions. The majority of the argumentation consists of students proposing alternative envisionments that end in desirable or undesirable states or events.

In response to Marla, Carl reaffirms in Turn 3 that Willie cannot win the race (and therefore, presumably, that Willie cannot tie, either). He attempts to recast Marla's envisionment as an impossible envisionment, one that cannot happen. Marla's response is a clever maneuver to strengthen her causal sequence by linking two causal sequences that are as yet unconnected; she links the sequence in *2a* with the sequence in *2b*. She asserts that Willie's misfortune would lead Stone Fox to feel sorry for Willie, which would in turn make him decide to let Willie tie him. Thus, Marla creates a series of links between a node that Carl agrees to be valid, the dog's dying, and Stone Fox's possible decision to let Willie tie him.

Figure 3 suggests that the argument between Marla and Carl in Turns 1 through 4 consists of constructing envisionments that terminate in states or events that the discussants take to be desirable or undesirable. This is the predominant pattern in all of the discussions that have been examined. For instance, students who want Willie to win construct envisionments in which Willie's victory has positive consequences (Willie can save the farm and he and his grandfather can continue to live there) and envisionments in which Stone Fox's victory has negative consequences (Willie and his grandfather have nowhere to go). By contrast, students who favor Stone Fox's victory construct envisionments in which Stone Fox's victory has positive consequences and Willie's victory has negative consequences.

Causal networks alone cannot account for all aspects of the argumentation. Figure 3, for instance, shows that some of the causal links are supported by evidence. Marla supports the idea that the dog's death would upset Willie by appealing to her peers' empathetic emotional reactions. She supports the idea that she herself would be upset with additional evidence that she was sad when her family had to get rid of their dog. This evidentiary support takes the form of Toulmin-like argument frames embedded within the causal network.

Like argument networks, causal networks provide a powerful tool for investigating the character of dialectical discussions in classrooms. In the two discussions that have been exhaustively analyzed, a large majority of all statements fall into envisionments. However, although fourth graders frequently imply or state that the terminal events in these envisionments are desirable or undesirable, they seldom justify these value judgments; less than 5% of value judgments are defended or justified. Similarly, the students almost never weigh the relative desirability of different events or states (e.g., which is more highly desirable: recovering tribal lands or saving Willie's farm?). Very few causal connections (less than 5%) are supported or challenged with evidence, even though it appears that many of the proposed causal connections could reasonably be called into question. Such indicators are very useful for evaluating the progress of students as they learn to argue during discussions. It would also be interesting to compare discussions of adults with discussions by children on these dimensions, as well as to examine how different types of argumentation (ethical, scientific, etc.) differ.

A weakness of causal networks is that they fail to capture the sense in which students self-consciously advance reasons and evidence. During the discussions, students use such terms as *reasons*, *evidence*, *positions*, and *challenges* to refer to their own discourse. They sometimes summarize the discussion by listing lines of argument that they have considered so far. In short, the discussants often seem to conceptualize their discourse as sets of arguments and counterarguments. Causal networks are not organized in this way. It appears, then, that the discussions can be viewed as being organized both as patterns of premises and conclusions in argument networks and as rival envisionments in causal networks. A complete understanding of the discussions appears to require representations that capture both patterns.

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