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Collaborative discourse, argumentation, and learning: Preface and literature review ☆

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ABSTRACT

This article serves two functions. First, it addresses why studying collaborative discourse and collaborative argumentation is important for promoting students' deep-level understanding of content. A literature review is presented examining the evidence for this claim, concluding that engaging in collaborative discourse and argumentation might have long-term effects in consolidating learning gains. Second, the various articles in this special issue are introduced. The articles address important directions for research, including (a) how to promote pedagogically useful collaborative discourse in the classroom and in workplace setting (for example by modeling and soliciting elaborative discourse moves or by engendering "polite" behavioral norms), (b) understanding the role of joint representations and mental models in collaborative discourse, and (c) methodological difficulties with analyzing nonindependent and categorical data. The importance for educational psychologists in understanding the interaction of cognitive and social processes is highlighted.

1. Introduction

The theme of this special issue is collaborative discourse, argumentation, and learning. Educational psychologists are, by definition, interested in learning, but a focus on individual differences in combination with the cognitive revolution has often tended to focus educational psychologist on "what goes

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on in the head of students" to the neglect of social processes. Yet learning is often a social process, as something that goes on among students or between students and a teacher.

Fortunately, the neglect has not been absolute; for some time, there has been an effort among some educational psychologists to integrate cognitive and social processes. Pioneering work in this area has been conducted by Richard Anderson (Anderson, Chinn, & Chang, 1997), Deanna Kuhn (Kuhn, Shaw, & Felton, 1997), O'Donnell, Dansereau, and Hall (1987), Palinscar and Brown (1984, see also, Brown & Campione, 1990); Lauren Resnick (Resnick, Salmon, Zeitz, & Wathen, 1993, Scardamalia and Bereiter (1991), Webb (1995) and others. The articles in this special issue build on this earlier work.

A special issue in *Contemporary Educational Psychology* also is a sign, I hope, that the study of collaborative discourse and argumentation is becoming more "main stream." As a graduate student in educational psychology in the mid-90s, I chose argumentation as a topic of research, both because of my interest in critical thinking and because of its use by some educational reformers. But as I began working in academia as a faculty member, the reaction of my colleagues was mixed. Some were enthusiastic but others were unclear what argumentation, a topic usually studied by philosophers, had to do with educational psychology. Fortunately, since the mid-90s, research on argumentation and collaborative discourse has grown and blossomed.

Some of the interest in argumentation stems from the need to teach students reasoning skills. Halpern (1998) cites the prevalence of pseudoscientific thinking in American society (widespread belief in astrology, untested health remedies, etc.), and mentions argumentation as one major component of the type of thinking skills that students need to be taught. In a democracy, the ability of citizens to think critically is paramount, and this includes the ability to evaluate arguments and counterarguments in relationship to a variety of issues (genetically modified foods, solutions to global warming, etc.). Even at a personal level, considering arguments for or against different options is important (e.g., decisions about changing careers, where to buy a house, etc.). Groups also use argumentation to make decisions and perform tasks, for example, planning an effective course of treatment for a patient (see Hagler & Brem, and Lu & Lajoie, this issue). In clinical psychology, cognitive treatments involve the replacement of distorted arguments and thinking patterns with more rational arguments. In short, effective argumentation skills are central to critical thinking and sound decision making at a variety of different levels.

In addition to teaching critical thinking, argumentation may be important for learning. A central tenet of social constructivism is that knowledge is "socially constructed" (Berger & Luckmann, 1966), but exactly what is knowledge and how is it constructed? If knowledge is considered "verified true belief," arguments and counterarguments are needed to verify the beliefs (Petraglia, 1998). In fact, what is socially constructed is an argument with a certain amount of strength. From a cognitive perspective, argumentation and collaborative discourse are frequently thought to promote conceptual understanding and deeper learning of content. A number of researchers and educational reformers have used argumentation practices for the teaching of content in various subjects, including science (Driver, Newton, & Osborne, 2000), mathematics (Lampert, Rittenhouse, & Crumbaugh, 1996), reading (Anderson et al., 2001), and comprehension of issues in history and social studies (De La Paz, 2005). These practices typically involve students in oral or online discussions where (ideally) students evaluate arguments and counterarguments. However, given the growing body of research on argumentation and collaborative discourse, it is now appropriate to address a number of questions: (a) what is the evidence that collaborative argumentation and discourse can actually promote learning, and under what circumstances? (b) What are some of the ways that pedagogically effective collaborative argumentation and discourse can be promoted in the classroom? and (c) How do real-world practices of argumentation inform what is meant by "pedagogically effective?"

In this special issue, six articles are presented. The present article (by the first co-editor, E. M. Nussbaum) is a literature review on the research on collaborative discourse, argumentation, and the relationship to learning outcomes, which was one of the foci of the special issue call. To foreshadow, key conclusions of this review are that for collaborative discourse and argumentation to enhance conceptual understanding of content, there needs to be a focus in the discussions on resolving sociocognitive conflict, considering and evaluating diverse views, understanding conceptual principles, and creating social and cognitive norms where participants will use and, just as importantly, model for one another elaborative and metacognitive strategies. All of these processes require that instruction provide

students with sufficient time to develop norms and to reflect and understand conceptual principles. Scripting discourse with roles and procedures has limitations, but some prompting of elaborative and metacognitive thinking is useful. There is some evidence that collaborative discourse and argumentation make learning gains more permanent, but more research is needed here.

The question arises as to how these features of productive discussion can be facilitated by teachers. The second and third articles address this question. The second article, by Webb, Franke, Ing, Chan, Tondra, and Freund, addresses teacher practices that foster explanation construction in middle-school classrooms. Explanations are an important part of collaborative discourse and are closely related to arguments. As with their previous work, the authors find that having students give explanations is more predictive of learning gains than receiving explanations or just giving answers. The article extends previous work to explore what sort of teacher practices facilitate constructive student discourse. The authors find that having teachers solicit explanations from students, rather than giving explanations themselves, is key to fostering the types of classroom environments that are conducive to collaborative discourse. The article explores some of the subtleties and dynamics for how teachers solicited explanations in these classrooms.

The third article, by Chui, addresses a broad array of social factors for creating open discussion in middle-school algebra classes. The article specifically focuses on the generation of new ideas in small groups, and finds that rudeness—disagreeing with others in a direct and confrontational way—is less effective in generating new ideas than polite disagreement. It therefore becomes important to teach students how to disagree with one another politely. The Chui study is also notable in its use of multilevel modeling. Student behaviors in small-group discussions affect one another in a variety of ways; the lack of independence is a serious violation of statistical assumptions. Many studies relating to collaborative discourse and argumentation have failed to control for this problem; Chui demonstrates one approach for addressing it.

In respect to the question, how can real-world argumentation practices inform educators as to what argumentation skills should be taught, the fourth article, by Hagler and Brem, is a qualitative piece exploring the social dynamics of argumentation during nurses' change-of-shift reports. Although this is a study conducted in a workplace setting, it has important implications for nursing education, specifically what sorts of things should be taught to nursing students regarding argumentation and critical thinking (and therefore what sorts of argumentation practices may be important to stress in the classroom or during clinical apprenticeships). There may also be some similarities to other domains of learning, but the authors stress a domain-specific approach to thinking and argumentation. More general, structural approaches, for example describing the parts of an argument or how arguments relate to one another, are found to be weak in describing what nurses actually do. The piece also has theoretical implications relative to how argument pragmatics (the purpose for which arguments are made) affects the structure of discourse. Nurses who are coming onto a shift must be briefed by the nurses coming off regarding the condition of the patient and what type of care is appropriate. Firm prescriptions are not discussed or debated because the patient's condition can change rapidly. Rather, it is important, from a pragmatic perspective, for the ongoing nurse to have a "clear picture" of the patient's existing condition and some of the events leading up to it. When nurses argue with one another, they do so in a polite way, often with questions or by withholding cues of agreement (eye contact, relaxed posture) for the purpose of gaining a "clear picture." The argumentation context can be characterized by what Walton (1999) termed an "information-seeking" dialogue rather than a persuasive dialogue. Arguments are made as to the reason for certain conditions and the effects of certain actions and alternative actions, but for the purpose of generating "a joint mental model of the situation" (Salas & Cannon-Bowers, 2001). Although Hagler and Brem do not themselves draw firm pedagogical conclusions, classroom instruction on argumentation (in conjunction with clinical observation) could address cases of arguments embedded in different discourse types, the pragmatic goals of these types, social methods of indicating agreement and disagreement, and the role of joint mental models in decision making.

The fifth article, by Lu and Lajoie, explores the concept of joint mental models further. It presents a qualitative study, also from the realm of medical education. It is specifically a case study of several classrooms where medical students were required to manage the care of a patient whose condition was rapidly deteriorating. Some students used interactive whiteboards to discuss the patient's

condition; others did not. Analysis of the discourse suggested that the interactive whiteboards better enabled the participants to establish a clear and common picture of the relevant facts and principles. Lu and Lajoie conclude that the joint mental model better enabled the medical students to engage in more effective patient management.

The final article is by Tzu-Jung Lin and the other guest co-editor, Richard C. Anderson. The piece discusses the findings of the four contributions to this issue and their implications for argument theory. The authors discuss the value of generating disagreement (focused on by Chiu) versus reaching agreement (focused on by Hagler & Brem as well as Lu & Lajoie). They also address the relative merits of making arguments with some implicit premises versus greater explicitness.

2. Foundational concepts

In this introduction to the special issue, I review some of this research on collaborative discourse and argumentation, so that the reader will have a sense of where this topic is grounded and where it is headed. This review sets the context for the other articles in this issue. It focuses primarily on the relationship of collaborative discourse and argumentation to learning outcomes, specifically conceptual learning of content. It therefore does not address the development of reasoning outcomes (such as knowledge of argumentation) or the rich literature on written argumentation. I also focus on individual rather than group outcomes. Groups certainly should co-construct knowledge (represented as arguments), but ultimately individuals will leave the group and enter into new situations (Greeno, Smith, & Moore, 1993). It is therefore important to know if there are any residual effects on learning from the initial group situation.

I have also focused the literature review on studies that have found strong statistical results, usually with statistical significance levels below 0.01. As explained later, and by Chui (this issue), results can be artificially inflated by a failure to address the violation of statistical independence assumption of statistical hypothesis testing.

2.1. What is collaborative discourse and collaborative argumentation?

There is a small but growing body of evidence that collaborative student discourse (i.e., reflective discussions among students about academic content) can sometimes promote deep and meaningful learning. Argumentation theory provides an analytic framework for assessing the quality of discussions and student artifacts in terms of depth of reasoning, amount of backing for claims, and consideration of counterarguments. Nevertheless, not all researchers examining students' oral interactions in education specifically use argumentation as an analytic framework, so the guest editors have broadened the focus of the special issue to also include collaborative discourse. But what do these terms mean?

2.1.1. Meaning of argumentation

Argumentation is a term with several meanings. In his seminal 1982 paper, O'Keefe (1982) distinguished between two senses of the word argument, argument-1 ("argument as product"), which consists of a series of propositions in which a conclusion is inferred from premises, and argument-2 ("argument as process"), which refers to the social processes in which two or more individuals engage in a dialogue where arguments are constructed and critiqued. Thus, a classroom discussion, in which students are making and evaluating one another's arguments, would be a form of argument-2. Argument products are tangible artifacts that are the products of students' individual or collaborative reasoning. Such reasoning can also be observed more directly through observing student discussion or, for individual reasoning, through think aloud-protocols.

2.1.2. Why collaborative?

Researchers frequently modify the term *argumentation* with the term *collaborative* to emphasize that they are not referring to debate. I define collaborative argumentation as a social process in which individuals work together to construct and critique arguments (Golanics & Nussbaum, 2008;

Nussbaum, 2002; see also Brown & Renshaw, 2000; Cobb & Bauersfeld, 1995). Unlike a debate, students do not have to take sides and persuade others, but are free to explore positions flexibly and to make concessions. While actual empirical comparisons of adversarial and collaborative argumentation are relatively rare, Keefer, Zeitz, and Resnick (2000) discovered, when studying small-group discussion of literary texts, that collaborative argumentation resulted in deeper arguments and better understanding of literary themes than did adversarial argumentation. Wegerif, Mercer, and Dawes (1999) provided evidence showing that collaborative argumentation among students (termed "exploratory talk"), specifically regarding the best way to solve Raven Progressive Matrices, resulted in greater individual performance than did conflictual or agreement-oriented discourse. Research by Nussbaum (2002) indicated that introverts tend to prefer collaborative over adversarial discourse. This finding suggests that some students may find adversarial argumentation more intimidating and "face-threatening" (Goffman, 1963); the threat of losing an argument can damage the image that students project to others and to themselves (see also Chiu, this issue; Lampert et al., 1996). These studies point to the advantages of making argumentation collaborative. Although some researchers (Johnson & Johnson, 1985; Kuhn & Udell, 2003) have used interventions with a component of adversarial argumentation (e.g., debate), they combine it with large amount of collaborative argumentation, for example in preparing for the debate.

Although the bulk of evidence suggests that collaborative discourse is more valuable in most educational environment over adversarial argumentation, the amount of attention this issue has garnered is relatively low and therefore the findings here should not be considered conclusive.

2.1.3. Collaborative discourse

Some researchers use the term *collaborative* discourse rather than *collaborative argumentation* because the researcher's interest may focus on speech acts such as explanation that are technically different from argumentation (see, for example, Webb et al., this issue). According to Govier (1987), although explanations and arguments often have similar structure (a conclusion supported by premises), in an explanation, the truth of a conclusion is accepted by the participants and in an argument, it is not. In practice, student collaborative discourse will contain a mixture of arguments, explanations, and a variety of other discursive activities, but of course different researchers focus on different elements.

2.1.4. Critical, elaborative discourse

Not all types of collaborative discourse and argumentation are equally valuable to students' learning. Discourse may be unfocused or shallow, and may contain few arguments or evaluation of arguments. Therefore, it is necessary to coin a new term that expresses the key features of discourse that theoretically and empirically may enhance conceptual learning. The term is "critical, elaborative discourse." The term "critical" comes from the notion of a critical discussion in philosophy (van Eemeren & Grootendorst, 1999) where participants assume different points of view and use arguments, counterarguments, and refutations to resolve their conflicting opinions. From an educational perspective, some posit that students need to evaluate alternative perspectives if conceptual change is to occur (see Dole & Sinatra, 1998). The term "elaborative" refers to students generating connections among ideas and between ideas and prior knowledge (Wittrock, 1992). Students can elaborate misconceptions, but the addition of the term "critical" implies that different viewpoints will be considered. (See also Linn & Elyon, 2000, for explanation of a similar idea, *knowledge integration.*)

2.2. Philosophic frameworks

2.2.1. Philosophic models of argumentation

Considering philosophic work on argumentation is important because this work provides normative standards by which the structure and quality of arguments can be judged. Although there is foundational work by Aristotle in both the formal and dialectical nature of arguments (Walton, 2003), much contemporary work in argumentation is rooted in Toulmin's (1958) model, which holds that arguments can be analyzed using the categories of claim, grounds, warrants (linking ground to claims), backing, rebuttals, and qualifiers. The model has been widely used in educational research

on argumentation (see, for example, Cho & Jonassen, 2002; Erduran, Simon, & Osborne, 2004; Kelly, Drunker, & Chen, 1998; Kenyon & Reiser, 2006; Krummheuer, 1995; Voss, Tyler, & Yengo, 1983).

Some educational researchers use other contemporary philosophic frameworks, such as van Eemeren and Grootendorst's (1999) model of a critical discussion (e.g., Nussbaum, 2003; Weinstock, Neuman, & Glassner, 2006). The model prescribes certain rules of discourse that participants must follow. Walton (1999) presents another model in *The New Dialectic*, which analyzes rules of discourse and use of argumentation schemes in the context of specific sorts of dialogue, e.g., persuasive discussions, inquiries, negotiations, etc. (see Nussbaum, in press; Duschl, in press). These other frameworks are more dialectical than Toulmin's, meaning that there is a focus not only on the structure of arguments as products (O'Keefe's argument-1), but also on the socially interactive process of constructing and critiquing arguments (O'Keefe's argument-2). These alternative frameworks are also more pragmatic, meaning arguments must be judged contextually by the goals of the type of discourse in which participants are engaged. The distinction between structural and pragmatic approaches is further taken up in this issue by Hagler and Brem.

2.2.2. Informal argumentation

All the contributions in the special issue examine informal reasoning, that is, reasoning used in natural contexts, particularly mathematics classrooms and medical settings. The term "informal" reflects one of Toulmin's points (1958) that formal logic is insufficient for the study of arguments naturally made in discourse. Formal logic is deductive, meaning that the conclusion follows with absolute certainty from the premises. Informal arguments can also be inductive, meaning that the conclusion only follows probabilistically from the premises, or abductive, meaning that the conclusion is the best available explanation of the evidence (Walton, 2003). With informal arguments, there is a gap of uncertainty between the premises and conclusion. Although not comprehensive, informal logicians have developed a number of criteria for evaluating informal arguments, such the relevance, sufficiency, and truth of the premises (Blair & Johnson, 1987). Erduran et al. (2004), using Toumin's model, have proposed that the quality of arguments is a function of the number of counterarguments, rebuttals to the counterarguments, and qualifiers made. Based on the earlier work of Leitão (2003), Nussbaum and Schraw (2007) proposed the concept of argument–counterargument integration, in which the strength of an argument is a function of how well a conclusion accounts for counterargument by refuting, discounting, or accepting the counterarguments, or by proposing a creative solution that eliminates possible objections. This model has been successfully taught to undergraduates (Nussbaum, in press; Nussbaum & Schraw, 2007; Nussbaum, Winsor, Aqui, & Poliquin, 2007).

One philosophic foundation for these models is Pollock's (1987) notion of defeasibility, that a strong argument is one that can successfully withstand all objections (i.e., defeat all the defeaters). Defeasibility implies that good arguments will not only include evidence for assertions (Toulmin, 1958), but also rebuttals, qualifiers, and other integrating devices. These approaches do not totally solve the problem of how to judge the quality of arguments, because even an integrated argument may fail to consider some important constraints. (See Clark & Sampson, 2008, for one attempt to address this problem.)

The concept of defeasibility does provide one reason for why argumentation researchers examine such things as counterarguments and rebuttals (e.g., Kuhn, 1991; Nussbaum & Kardash, 2005; Reznitskaya et al., 2001) and encourage students to generate these elements in their discourse. Doing so can be an important reasoning outcome. But can considering and evaluating arguments and counterarguments also promote the learning of content, specifically the understanding of concepts and principles in science, mathematics, and other subjects? The next section examines this important question in more detail.

3. Psychological research

Psychologists have researched two general mechanisms for why collaborative discourse and collaborative argumentation may foster the development of content understanding: (a) sociocognitive conflict, and (b) cognitive elaboration. There are also effects of argumentation on intrinsic interest

and motivation (Chinn, 2006), but these are less relevant to the pieces in the special issue and therefore are not discussed here. The evidence supporting each of the cognitive mechanisms is described below.

3.1. Sociocognitive conflict theory

Early work on social interaction in argumentation was conducted by sociocognitive conflict theorists. This work was based on Piaget's notion that conceptual change occurs through cognitive conflict, and cognitive conflict could be triggered by social disagreement and argumentation over some sort of judgment (Mugny & Doise, 1978). Researchers have primarily conducted this research with cognitive developmental tasks or with science problems related to conceptual change.

3.1.1. Developmental tasks

Sociocognitive research provides early evidence regarding the educational importance of collaborative discourse and argumentation. Commencing with the work of the "Genevan" school, developmental research has focused on group discussions regarding conservation tasks or spatial manipulation tasks. A typical study concerning conservation was Murray's finding (1972, 1982) that asking dyads composed of a conserver and a nonconservers to make a conservation judgment together resulted in substantial gains in conservation on one-week, individual delayed post-tests (Murray, 1972, 1982). Glachan and Light (1982), in reviewing the literature, concluded that cognitive growth is most pronounced when the conserver gives arguments in support of her or his position and counterarguments against the partner. This research therefore provides initial evidence regarding the educational importance of collaborative discourse and argumentation.

There is also some evidence in support of a phenomenon known as "two wrongs make a right." This phenomenon refers to the situation where two individuals, each with different but incorrect solutions, collaboratively discuss their respective viewpoints, often resulting in discovery and deeper understanding of a more correct solution strategy. For example, placing two nonconservers at the same "operational level" together can result in discussions of different but incorrect solutions. Cognitive growth is often observed (Doise et al., 1975, 1976; Glachan & Light, 1982; Mugny & Doise, 1978), including strong effects on delayed post-tests (Ames & Murray, 1982).

Glachan and Light (1982) argue that the children involved in the "two wrongs make a right" phenomenon often make cognitive moves that they would not normally make, thus discovering that their original viewpoints or strategies are ineffective. Schwarz, Neuman, and Biezuner (2000), replicated this result with low-achieving Israeli high school students solving decimal fraction problems. It appeared that the effect worked because dyad partners who had different conceptual bugs tended to use hypothesis testing to resolve their disagreements more than dyads where one student used the correct strategy. In the latter condition, the authors postulate that the "right" student was less engaged and not operating under a condition of uncertainty, therefore collaborative argumentation and hypothesis testing were less likely.

Overall, this research suggests that difference of viewpoints can trigger sociocognitive conflict, and when this conflict is resolved through discussion and hypothesis testing, better and more lasting learning is obtained. In this issue, various authors discuss conflict and hypothesis testing, including Chiu (in the context of using polite disagreement to explore new ideas), and Lu and Lajoie, where hypothesis testing is observed during a simulated medical emergency.

3.1.2. Sociocognitive conflict in science

Research on sociocognitive conflict also has a long history in science education (Limón, 2001). Guided and well-structured discussions can be a vehicle for students to focus on problems with existing conceptions (Chan, 2001). For example, citing a qualitative study by Dreyfus, Jungwirth, and Eliovitch (1990), Limón (2001) argues that discussions can be useful for helping to render conceptual conflicts more meaningful to students. In addition, some evidence suggests that students' prior conceptions need to be made public, held open for scrutiny, and contradictions emphasized by the teacher (Bell & Linn, 2000; Hunt & Minstrell, 1994) or by frequent encounters with anomalous data (Echevarria, 2003). As with the developmental research, discussion related to the evaluation of different

hypotheses appears to be key. Driver et al. (2000) contend that the key role of discourse in conceptual change is not so much to induce cognitive conflict, although that may still be important, but to provide students with an opportunity to reconstruct their knowledge. (See Chan, Burtis, & Bereiter, 1997, for some supporting data.) This points to the importance of the second major mechanism linking collaborative discourse and argumentation to learning outcomes, cognitive elaboration.

3.2. Cognitive elaboration theory

A second theoretical perspective, cognitive elaboration theory, highlights the value of argumentation in stimulating deeper learning (O'Donnell & King, 1998). Cognitive psychologists have found that deeper processing is associated with more effective memory and learning (Craik & Lockhart, 1972). These effects may occur because of elaborative rehearsal. Specifically, argumentation may encourage students to generate relationships among concepts and with prior knowledge (Wittrock, 1992), thus creating multiple routes for the recall of information, and therefore more durable learning. Argumentation may also help students become attuned to more conceptual relationships and constraints (Greeno & van de Sande, 2007), to identify and repair flaws in their mental models (deLeeuw & Chi, 2003), and to consider and adopt alternative conceptions (Reiser et al., 2001). Of course, students must generate rich and elaborate arguments or explanations, not superficial ones, for these effects to occur. I will first discuss research on explanation, and then some of the classroom-based and experimental research on both argumentation and explanation.

3.2.1. Research on explanation

Collaborative discourse and argumentation involve explanation when, for example, learners explain their points of view. In this issue, Noreen Webb and colleagues expand on her classic series of studies (Webb, 1991, 1995), where she found levels and elaborativeness of explanations in cooperative groups predicted more individual learning in mathematics, with the highest growth associated with those generating explanations. Cognitive elaboration theory accounts for this effect because explainers may need to generate additional, elaborative links in their knowledge base to generate an explanation, especially where they find there are gaps in their understanding.

Some additional supporting evidence comes from Chinn, O'Donnell, and Jinks (2000), who asked fifth-grade students in groups of four to discuss results of experiments on electricity. Chinn et al. found that the more complex explanations (measured by number of nodes in a network representation) correlated with individual learning gains.

Explanation construction can be considered a type of elaboration that promotes depth of processing. There is evidence that peer discussions are most effective when students attempt to abstract general principles in conjunction with experimental testing of their hypotheses (Amigues, 1988; Heller, Keith, & Anderson, 1992; Howe, Tolmie, Greer, & Mackenzie, 1995; Linn & Elyon, 2000; Teasley, 1995).

On the other hand, Ploetzner, Dillenbourg, Preier, and Traum (1999) reviewed a number of studies finding that explaining to others was less effective than self-explaining and about as effective as listening (see, for example, Bargh & Schul, 1980; Coleman, Brown, & Rivkin, 1997; Teasley, 1997). Coleman et al. (1997) argue that when preparing to teach, one must "reorganize the material in an efficient manner so that the hearer (listener) can understand it" (Coleman et al., 1997, p. 359). Reorganization requires in-depth cognitive processing. On the other hand, when explaining something to another, students might try less hard to make sense of the material, and may face higher cognitive load specifically from trying to manage the social interactions and learning of the listener simultaneously (Renkl, Gruber, & Mandl, 1999).

A limitation of this body of work is that it consists almost exclusively of one-session experiments. This factor could account for limited effectiveness of explaining to others. Although Webb's (1991) research did find that elaborative explaining did correlate with learning, her studies were more long-term (e.g., six weeks) and involved small groups of three or four, rather than dyads; larger groups may involve lower cognitive load than dyads related to managing social interaction (Renkl et al., 1999).

It is therefore always important to consider group size and the length of the intervention. A more extended intervention would allow students some time to think about the concepts, so their explana-

tions may reflect more knowledge restructuring. Thinking about concepts over time is somewhat like preparing to teach, although one is actually preparing to engage in collaborative discourse or argumentation. Webb et al. (this issue) give details of how, over time, students learn to give elaborated explanations.

3.2.2. Classroom-based research

Classroom-based research, while often less-well controlled, does have an advantage that interventions are typically long-term. For example, Aulls (1998) conducted an extensive case study comparing two Grade-8 classrooms studying ancient Egypt, and found higher levels of recall in the more dialogic classroom. The more dialogic classroom had significantly more teacher questions, student questions, and explanation construction. There was also more instruction on learning strategies, especially pertaining to elaboration. Many discussions were focused on forming connections between ideas, which is an important component of elaboration. There was also a variety of discourse forms (eight, specifically) in the more dialogic classroom. The case study, while not definitive, does highlight how collaborative discourse can lead to learning through the causal mechanism of elaboration. This occurred through sustained classroom discourse over a prolonged period, which is true of all of the studies so far discussed finding a positive relationship between discourse and learning. Some more large-scale research provides confirming evidence of the correlation of critical, elaborative discourse with learning outcomes, specifically comprehension and interpretation of literature (Applebee, Langer, Nystrand, & Gamoran, 2003).

3.2.3. Experimental research

Many of the findings discussed so far in this literature review are based on correlational or qualitative data, or are limited because effects on individual learning outcomes were not considered or were ambiguous. There are some exceptions, such as the research on peer explanation and the sociocognitive developmental research, but the latter used a very restrictive set of tasks.

There is therefore a need for more experimental studies that establish a causal link between critical, elaborative discourse and content learning outcomes. There are only a couple of experimental studies that have sought to establish such a causal connection.

3.2.3.1. Zohar & Nemet (2002). These researchers conducted a quasi-experiment with nine intact ninth-grades classes, with those in the experimental group given explicit instruction on the qualities of a good argument (e.g., relevancy, soundness, consideration of counterarguments) and opportunities to twice discuss dilemmas on human genetics. The control classes simply solved standard human genetics problems. The experimental group showed substantial growth on a test of human genetics knowledge because, the authors argue, collaborative discussions allowed them to better integrate new knowledge with prior knowledge. A weakness of the quasi-experiment is that the experimental and control groups were judged qualitatively to be equivalent, but no supporting quantitative data were provided.

3.2.3.2. Asterhan & Schwarz (2007). A recent set of true experiments by Asterhan and Schwarz (2007) sought to establish a causal connection of collaborative argumentation with learning. Their first experiment involved undergraduates watching a movie on the theory of evolution. Students then discussed in dyads two problems related to evolution (e.g., how would the theory explain a certain trait change in a species). Some dyads were instructed to reach the best solution together (control condition); others were instructed to have a critical discussion by arguing for and against different solutions. Experimental group participants maintained gains from a pretest to a one-week delayed post-test on an individually administered test of conceptual understanding, whereas control subjects showed gains on an immediate post-test but did not preserve these gains. The authors surmise that deeper processing by the experimental subjects could have accounted for the preservation of gains, whereas control subjects showed only temporary gains from exposure to information from their partner or the movie. The effect size was small, however, because of variations in how experimental group students conducted critical discussions. Correlational analysis showed that students who engaged in dialectical, two-sided discussions

showed a one standard deviation gain in conceptual understanding from pretest to delayed post-test.

A second experiment was conducted to provide more causal data on this point. Asterhan and Schwarz used a student confederate as a member of each dyad; the confederate asked the partner a number of questions that made critical discussions much more likely in the experimental group. Control subjects just read their problem answers to the confederate and vice versa. The intervention resulted in a medium effect size ($\eta^2 = .14$) with experimental participants having an advantage on both the immediate and delayed post-test.

This is an important finding because it experimentally establishes a causal connection between critical argumentation and greater conceptual understanding, although the researchers needed to use metacognitive prompts by the confederate to induce more students to examine arguments and counterarguments. The Asterhan and Schwarz study therefore underscores the importance of providing students with metacognitive prompts promoting critical, elaborative reasoning. There is a substantial body of research showing the usefulness of prompting students to think and ask higher order questions during discussions (Beck, McKeown, Hamilton, & Kucan, 1997; King, Staffieri, & Aldelgais, 1998; Meloth & Deering, 1999; Larson et al., 1985; Palinscar & Brown, 1984). Davis (2003) found that generic prompts ("stop and think," "what are you confused about?") were more effective than directive prompts ("think about X") because the former exposed students to a greater variety of ideas and better prompted reflection. This in turn enhanced the learning of scientific principles, as judged by the quality of students' science projects. Generic prompts appear to work better than specific questions about content (see also Mäkitalo, Weinberger, Häkkinen, Järvelä, & Fisher, 2005). In addition to generic prompts, students need (a) training on group norms and (b) practice in group discussions, in order to build collaborative reasoning skills (Blatchford, Baines, Rubie-Davies, Bassett, & Chowne, 2006; Cobb, 1995; Kazemi & Stipek, 2001). Several authors in this issue discuss norms appropriate for different settings: explanatory norms (Webb et al.), politeness norms (Chiu), and norms appropriate for real-world, medical settings (Hagler & Brem, Lu & Lajoie).

Another important point suggested by the Asterhan and Schwarz (2007) study is that engagement in critical, elaborative discourse can help maintain learning gains over time. Evidence for this claim is provided by participants' performance on the delayed post-tests. The sociocognitive studies on conservation have also found delayed effects (Ames & Murray, 1982; Murray, 1972, 1982). One theoretical possibility is that, while watching a movie or reading a text may help students grasp certain structural relationships, collaborative discourse and argumentation function to strengthen the neural links representing these relationships and to forge additional links, including links with prior knowledge (both excitatory and inhibitory). These factors would make it easier for students to recall and reconstruct their knowledge at a later point in time. One might say that the student's understanding has become more "integrated" (Linn & Elyon, 2000). More research supporting this explanation is, however, needed.

In summary, the research suggests that collaborative discourse and argumentation can strengthen and preserve learning and understanding when students have an opportunity to engage in hypothesis testing, when they focus on conceptual principles, and when metacognitive reflection is prompted or promoted by ground rules and group norms. Immediate effects should not be expected, but collaborative discourse and argumentation may function to preserve learning gains over time.

4. Directions for future research

Based on this review, some additional suggestions can be made as to productive directions for future research. First, more attention in the field needs to be given, not just to how students elaborate ideas, but also how they can test their ideas and hypotheses and can model for one another critical, elaborative discourse. Some research on the latter has been conducted by Anderson et al. (2001), who found that when students discuss stories using a technique known as collaborative reasoning, students appropriated from one another certain argumentation behaviors. Rummel and Spada (2005) use of a worked example, specifically a videotape of two people effectively collaborating on designing a therapy plan for a hypothetical patient, resulted in better collaboration and more effective

plans among psychology and medical students. The findings of these studies are provocative, and point to the need for further research on modeling and other social processes that promote critical discourse. In addition to experimental and classroom based studies, studies of workplace environments, such as the nursing environments explored by Hagler and Brem (this issue), or the medical school environments described by Lu and Lajoie (this issue), are fertile grounds for investigating how individuals are enculturated into certain argumentation practices. Such studies can also examine how hypothesis testing occurs in the real world.

Second, there continues to be a need for studies addressing how elaborative, critical discourse can be promoted in the classroom. Group discussions may be unproductive if most of the participants lack content knowledge, a commitment to mastery and understanding, and facility with higher forms of reasoning. Even if one or two members possess positive characteristics, they must feel safe enough to dissent and voice alternative views (see Chui, this issue). A large literature on this issue has accumulated relative to online discussions (Andriessen, 2006; Andriessen, Baker, & Suthers, 2003), but these efforts have either not been well linked to quantitative learning outcomes (of content matter) or the linkage has been disappointing (Fischer, Kollar, Mandl, & Haake, 2007; Hewitt, 2005; but see Hoadley & Linn, 2000, for an exception). It is important whenever possible to examine the issue of promoting critical, elaborative discourse along with measuring increases and maintenance of learning gains; otherwise, it becomes more difficult to determine if certain interventions actually promote discourse that is educationally valuable. Noreen Webb, who conducted the seminal studies on explanation construction, explores in the special issue, along with her colleagues, how explanatory discourse can be fostered in the classroom, and the effect on learning outcomes. Specifically, Webb et al. find that the more effective teachers elicited explanations from their students. Chiu (this issue) explores how one aspect of collaborative argumentation, the generation of new ideas, can be promoted in classrooms. Chiu specifically finds that whether students disagree politely or impolitely has a large effect on subsequent student discourse. This finding suggests that it may be important for teachers to model for students various ways that they can disagree politely. (Future research might also examine the effect of such modeling in online discussions.) Hagler and Brem (this issue) extend this work in examining how nurses disagree with one another during shift changes, and document specific linguistic practices that promote polite disagreement and promote agreement. These studies address specific practices that, when used by students, promote the frequency and quality of collaborative discourse.

Third, more research is needed on the effect of joint representations in enhancing the quality of collaborative discourse and argumentation. By a joint representation, I mean things like a diagram or text that participants construct and revise together. Schwartz (1995) found that dyads, working on science problems, were more likely to construct abstract visualizations than individuals working alone. Schwartz contends that occurred because of the need to create common ground, through a common representation, that everyone in the group could refer to. On the other hand, opportunities to create common representations in online environments, such as argumentation diagrams, have often not led to better individual learning outcomes (Cho & Jonassen, 2002; van Drie, van Boxtel, Jaspers, & Kanselaar, 2005). In this issue, Lu and Lajoie present a case study of a promising technology, interactive whiteboards, which may work better than previous technologies. They use the technology in a "real-world" situation, a simulated medical emergency, which creates a press for effective argumentation. Lu and Lajoie report that the whiteboards may have enabled medical students to construct a "joint mental model" of the patient. Hagler and Brem in this issue also highlight the importance of establishing a joint mental model among nurses so that they can continue care while reacting to unexpected changes in a patient's condition. Creation of a joint mental models is a hoped for by-product of joint representations. More research is needed on the relationship between common representations and critical, elaborative discourse, and the articles in the special issue address this need.

Fourth, more methodological research is needed on how best to conduct research on collaborative discourse and argumentation. Qualitative research has a vital place in helping us understand social and cognitive dynamics in schools and in workplace environments. Quantitative research has an important role for documenting causal effects, but often suffers from violations of the statistical independence assumption of traditional hypothesis testing. This assumption holds that individual cases do not affect one another in any way, but in collaborative discourse and argumentation, the whole point is to affect the opinions of other people (those in the same discussion group). There can even be

statistical dependence when participants are post-tested individually if there are carry-over effects from the group to the individual situation (e.g., higher motivation). These are group effects other than the one's being tested (which are assumed not to exist under the null hypothesis). For these reasons, if researchers fail to address the problem of statistical dependence somehow, then their "N" will be too high, statistical tests biased, and Type I errors more common. Some researchers use "the discussion group" as the level of analysis, but that may reduce the "N" too much, in the sense that statistical power may be decreased more than is necessary. In this issue, Chiu uses multilevel modeling to address this problem. Multilevel modeling controls for confounding group effects while testing the predictiveness of other variables. Chiu also uses other methodological refinements that address the categorical nature of much argumentation data, for example the use of ordered Logit models. Ordinary least squares would provide biased estimates and possibly a loss of statistical power if applied to such data, which is why argumentation researchers should pay serious attention to contemporary categorical and multilevel techniques. The most appropriate methodological adjustments for data of different sizes and structures is still an open question, but Chiu 's research provides one possible model.

Finally, more well-controlled, experimental research needs to be conducted, but the experiments should use long-term interventions and assess outcomes using delayed post-tests, given studies suggesting that collaborative discourse and argumentation may function to consolidate learning gains. It is also useful to include a major qualitative component in these studies, so that cognitive and social processes can be better understood. This is a tall order, but examples in the literature do exist (e.g., Reznitskaya et al., 2001).

With the possible exception of experimental research (which is discussed in this piece), the articles in this issue address most of these needs. To summarize, the articles address (a) how to promote collaborative discourse and argumentation in the classroom and the more specific question of modeling elaborative strategies, (b) the role of joint representations and mental models, and (c) some of the statistical problems of analyzing data from small groups. All the articles also address in various ways how to combine cognitive and social processes in one analysis, thereby not assuming cognition as something that only occurs "in the head." Hopefully, with the right mixture of cognitive, social and other ingredients, educational psychologists can see the further blossoming of this area of study.

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