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# Study group discourse: How external representations affect collaborative conversation

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## Abstract

In this article, we examine collaborative discourse in an informal undergraduate study group in which students focus on their lecture notes. Several decades of educational research have demonstrated that collaborative groups contribute to enhanced learning, and recent work has explored how external representations—such as those that appear in lecture notes—enhance collaboration. However, few of these studies have focused directly on the discourse processes that occur in collaborating groups, or how external representations influence these processes. In this article we use conversation analytic methods to show how the notebooks' external representations affect discourse processes and thus scaffold both individual and group learning. These analyses demonstrate that a close focus on discourse processes can help researchers understand how collaboration using external representations contributes to learning.

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## 1. Introduction

Over 20 years of educational research has consistently demonstrated that collaboration helps students learn (e.g., Bossert, 1988–1989; Johnson & Johnson, 1992; Kumpulainen & Mutanen, 2000; Slavin, 1990, 1992; Webb & Palincsar, 1996). For example, peer teaching has been shown to provide enhanced learning to both the teacher/tutor and to the student (Bargh & Schul, 1980; Fuchs et al., 1997; Palincsar, Brown, & Campione, 1993), and cooperative classroom groups have been demonstrated to result in greater learning than competitive or individualistically-structured learning environments (Johnson & Johnson,

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1974, 1979, 1989). Collaboration in structured, in-class formats has been shown to increase students' knowledge in a wide range of subjects, including biology (Lazarowitz & Karsenty, 1990), mathematics (Fuchs et al., 1997; Webb, 1991), composing narratives (Daiute & Dalton, 1993), and computer programming (Webb, Ender, & Lewis, 1986). These accumulated research findings have had a significant influence on educational practice; practicing teachers believe that collaborating groups provide a uniquely effective learning environment (Antil, Jenkins, Wayne, & Vadasy, 1998), and both large-scale assessment programs and small-scale in-class assessments increasingly use collaborative group work (Webb, 1995; Webb, Nemer, Chizhik, & Sugrue, 1998). The National Research Council's *National Science Education Standards* (1996) and the National Council of Teachers of Mathematics' *Professional Standards for teaching mathematics* (1991) both advocate negotiation and collaboration in inquiry.

The proven benefits of collaboration help to explain the widespread practice of university students forming their own informal study groups to go over material outside of class. In college study groups like the one studied here, students collaborate to resolve issues and to clarify material from lectures, lecture notes, or course readings. The task of the study group is to help the students appropriate the knowledge transmitted in the original lecture (Rogoff, 1995; Wertsch, 1998). Appropriation is a constructive process, in which learners actively create their own internal representations. Although many researchers have studied collaborating groups in primary and secondary school, there has been relatively little study of collaborating groups in post-secondary educational settings (exceptions include Berrill, 1991; Fisher, 1996; Middleton & Edwards, 1990; Stokoe, 2000; Viechnicki, 1997). Because studies have shown that collaboration is beneficial across a wide range of subjects, ability levels, and ages, these benefits may also generalize to college students. Research on American colleges has suggested that students learn most effectively and profoundly via interaction with peers (Bruffee, 1993). Most study groups form voluntarily, suggesting that the participants believe that collaboration will be mutually beneficial.

We analyze two aspects of study group discourse: how collaborative conversation contributes to learning, and how the students use their notebooks to help scaffold their collaboration. Thus, this study extends two recent traditions in educational research: the study of collaborative conversation, and the study of how shared external representations such as notebooks mediate learning. We demonstrate how these two complementary bodies of research can be brought together to better understand educational collaboration. Our broader goal is to show how conversation contributes to both individual and group learning.

### 1.1. Collaborative conversation

In explaining how collaboration benefits learning, researchers from a wide range of theoretical perspectives have hypothesized that social interaction mediates between the group and individual learning (Fisher, 1993; Johnson & Johnson, 1992; Kumpulainen & Mutanen, 1999, 2000; Mercer, 1996; Vygotsky, 1978; Webb, 1991, 1995; Webb & Palincsar, 1996). Researchers who study collaborative learning have focused on three aspects of interaction that could contribute to learning. First, providing and receiving explanations are both thought to contribute to children's learning (Bargh & Schul, 1980; Fuchs et al., 1997; Swing & Peterson, 1982; Vedder, 1985; Webb, 1984, 1991, 1992). Second, researchers

working within a Piagetian sociocognitive framework have emphasized the mediating role played by conflict and controversy (Bearison, Magzamen, & Filardo, 1986; Doise & Mugny, 1984; Miller, 1987; Perret-Clermont, 1980; Piaget, 1948, 1950). Third, researchers working within a Vygotskian or sociocultural framework have emphasized how participants build on each other's ideas to jointly construct a new understanding that none of the participants had prior to the encounter (Forman, 1992; Forman & Cazden, 1985; Palincsar, 1998).

All of these aspects of collaboration are conversational phenomena; explanations are provided in the context of the ongoing collaborative discourse of the group, and argumentation and elaboration are fundamentally discursive notions. In the sociocultural tradition emerging from Vygotskian and related theory, studies of collaboration have focused more specifically on discursive interaction (Durán & Szymanski, 1995; Forman, 1992; Gee & Green, 1998; Hicks, 1995, 1996; Palincsar, 1998; Richmond & Striley, 1996; Wells & Chang-Wells, 1992). Much of this research has combined Piaget's emphasis on cognitive conflict with Vygotsky's emphasis on social interaction, to develop a view that knowledge is co-constructed in social settings (Kelly, Crawford, & Green, 2001; Musatti, 1993; Rogoff, 1990, 1998; Tudge & Rogoff, 1989; Verba, 1994), and that meanings are socially constructed through discursive interaction (Lemke, 1990; Wells & Chang-Wells, 1992). An emphasis on the processes of group interaction, rather than educational outcomes, has been a defining feature of the sociocultural tradition.

These three distinct traditions—cooperative learning, Piagetian sociocognitivism, and Vygotskian socioculturalism—have not yet converged to form a unified, coherent study of collaboration, and publications in each area rarely reference those in the others. Nonetheless, these three traditions have reached a consensus that the processes of social interaction are the mediating mechanism whereby collaboration contributes to learning. Yet surprisingly, until the late 1990s there had been very little study of the discourse processes of collaboration—the turn-by-turn interaction patterns that occur among students in a group. Researchers in the cooperative learning and the sociocognitive traditions rarely use the detailed transcription methodologies of conversation analysis, instead developing higher-level coding schemes for behavior that often bypass transcription altogether (e.g., the papers collected in Hertz-Lazarowitz & Miller, 1992). Many studies that consider discourse code individual turns of dialogue, rather than examining the processes whereby those turns sequence over time in interaction (e.g., the papers in Hoyles & Forman, 1995; Kumpulainen & Mutanen, 2000; Webb, 1991; see also Cohen, 1994). The process orientation of the sociocultural tradition resulted in a greater concern with discourse; socioculturalists argue that knowledge is first collective and external—manifest in conversation—and then becomes internalized. However, socioculturalists tend to emphasize adult-child interaction rather than peer collaboration (cf. Tudge, 1990; Verba, 1994), and Cazden's (2001) book surveying discourse studies in education contained only 12 pages on peer discourse. Hicks' (1995) review of discourse and learning concluded by suggesting that “the general research question of how discourse mediates the construction of knowledge” should become a more explicit focus of educational research (p. 87).

In the late 1990s, the idea that conversation is responsible for the benefits of collaborative learning inspired a burst of research in how discourse contributes to learning. Recent studies have examined the discourse processes of collaboration in science (Boxtel, Linden, & Kanselaar, 2000; Finkel, 1996; Green & Kelly, 1997; Kelly & Crawford, 1997; Kelly et al.,

2001; Klaasen & Lijnse, 1996; Richmond & Striley, 1996), math (Chiu, 2000; Cobb, 1995; Cobb, Gravemeijer, Yackel, McClain, & Whitenack, 1997; Saxe, 2002; Saxe & Bermudez, 1996; Sfard & Kieran, 2001; Sfard & McClain, 2002), and literacy education (Durán & Szymanski, 1995; Gumperz & Field, 1995; Nystrand, Gamoran, Kachur, & Prendergast, 1997; Tuyay, Jennings, & Dixon, 1995). Many educational researchers have noted that collaborative discourse results in the emergence of new insights and representations, and that once they have emerged, these interactive social constructions both constrain and enable the ongoing collaboration (Cobb et al., 1997; Sawyer, 2001, 2003; Saxe, 2002). In this “emergent perspective” (Cobb et al., 1997; Saxe & Bermudez, 1996), a complete understanding of educational collaboration requires a focus on both individual development and on social change over time (Saxe & Bermudez, 1996). In group discussion, both the overall group dynamic and each individual’s learning collaboratively emerge from the group’s conversation. Collaborative emergence is characterized by improvisation, unpredictability, and responses that are contingent on each other. The meaning of a turn is not always clear at the moment it is spoken; meaning is often ascribed retroactively through a collective, discursive process (Cazden, 2001; Lemke, 1995). During successful collaborations, the group constantly constructs and maintains *intersubjectivity* or shared meaning (Forman, 1992; Forman & McCormick, 1995, p. 151).

Our focus is on discourse and communication as externally visible group knowledge, rather than on what goes on in participants’ heads (cf. Kelly et al., 2001, p. 268; Middleton & Edwards, 1990, p. 23; Sfard, 2002). We closely examine the collectively orchestrated temporal organization of collaborative talk, and we argue that this empirical approach can provide support for the sociocultural insight that knowledge and learning are often properties of groups, not only individuals (Rogoff, 1998). By focusing on the discourse processes of the study group, we extend prior studies with the goal of better understanding the mechanisms whereby collaboration helps students to accomplish a constructive appropriation of knowledge.

### *1.2. How external representations mediate collaboration*

A wide range of research has demonstrated that external representations—such as graphs, figures, maps, and text, either on paper or on a computer screen—can enhance the educational benefits of collaborative conversation (Cobb, 1995, 2002; Crawford, Sandoval, Bienkowski, & Hurst, 2002; Kelly & Crawford, 1997; Kelly et al., 2001; Lehrer & Schauble, 2000; Michalchik, Schank, Rosenquist, Kreikmeier, & Kozma, 2002; Saxe, 2002; Saxe & Bermudez, 1996; Sfard & McClain, 2002; Suthers & Hundhausen, 2002). This line of educational research draws on a recent tradition of studying collaboration in the workplace, particularly in groups whose interaction is mediated by technological artifacts like oscilloscopes, radar screens, or computer displays (Engeström & Middleton, 1996; Hutchins, 1997), and on studies of scientific laboratory practice, where external representations such as whiteboard scribbles or lab notebooks have a strong impact on discourse (Lynch & Woolgar, 1990; Ochs, Gonzales, & Jacoby, 1996).

In past studies of how collaboration is mediated by external representations, researchers have not analyzed how students shift between task-focused, mediated dialogue, and dialogue that is not mediated by the representation. For example, studies of the computer-

supported collaborative learning environment Knowledge Forum (previously known as C-SILE: Bereiter, 2002; Scardamalia & Bereiter, 1996) have focused on children's computer-mediated interaction (what they type to each other using the program) but have not videotaped children's verbal conversations while they are typing in these messages, even though researchers often observe students talking extensively while they type (as noted by Scardamalia, 2002; although see Cohen, 1995; Kelly & Crawford, 1996). In this article, we examine how the external representations in students' lecture notes affect the collaborative conversation of the group—both while they are attending to the notes and while they are not—thus extending prior research on how external representations mediate learning.

## 2. Methodology

We analyzed the discourse of a weekend study group of four undergraduate classmates at a Midwestern research university: Mary, Susan, Beth, and Jeremy, all juniors except for Susan, a sophomore. "Susan" is a pseudonym for the second author, who was a member of the study group. The students were science majors, Beth and Susan in psychology, and Mary and Jeremy in biology, with Mary minoring in psychology. The students were studying for a Fall semester class in Cognitive Psychology; they had all taken Psychology 100 as a prerequisite. The study group formed at the beginning of the semester, and their goal was to meet in advance of each of three exams to study for the exams. Mary and Jeremy, both third-year students, formed the group; they had known each other since their first year and had studied together in the past. Mary and Susan met before Fall classes began when they became suitemates, and Mary invited Susan to join the group. Beth was an acquaintance of Mary and asked to join the group. The students were not close friends outside of the academic context.

Prior to each exam, the group would convene for two sessions in the common room of the dormitory; each session lasted between 1 and 2 hours. The sessions were informal; the four members of the group positioned themselves in a circle, some sitting on couches or armchairs, and some lying or sitting on the carpeted floor. All of them brought their own lecture notes, and they frequently referred to the notes during the discussion. In each session, the group reviewed recent lectures in preparation for an examination that was to take place the following Monday. Each student had a notebook with notes taken from the lecture, and they used these notes extensively throughout the session (see Fig. 1). The lecture notes described the experiments and theories of seminal psychologists. The students used the names of the psychologists to distinguish different sections of their notes; each student's notes were organized in the same order that the professor originally presented the material in lecture, and the study group followed this order.

The goal of each session was to prepare for the upcoming exam by reviewing the lecture notes together. After the lectures, the group members did not examine their notes until the study group session, so each study group session was the first time that the participants revisited the material. The primary function of the discussion was to give the participants an opportunity to ensure that they understood the content—what the theories were and how the specific experiments supported the theories. A related function was to compare notes, so that if any one student was missing critical information, they could add it to their notebook.

sep 19

Automaticity

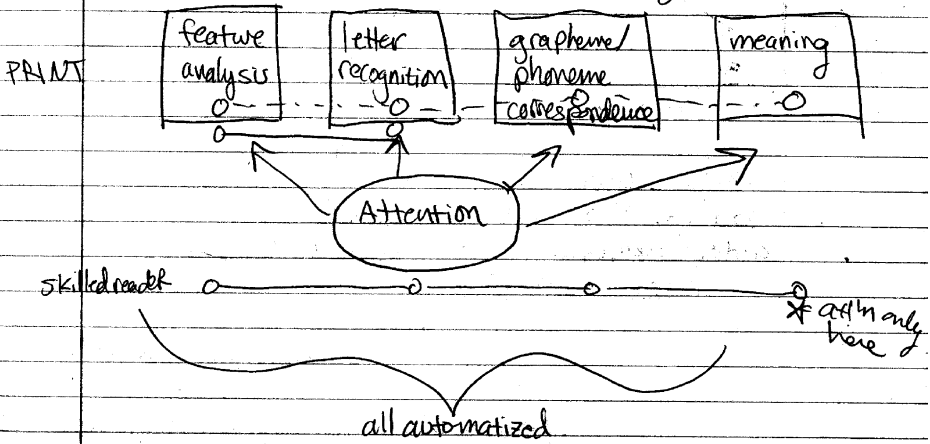
- Is there a qualitative difference?
- some tasks can be performed w/ NO capacity

count the F's

Healy - Unitization Hypothesis:

eventually, complex patterns become processed as single units & you lose ability to break it into its underlying constituents

LaBerge & Samuels - model of child learning to read



- ppl better @ detecting single letters in low-freq words than high-freq. words

Hardyck & Petrusic - in lip, throat, etc.

- measure EMG activity in ppl reading hard passages & easy passages
- found increase in EMG activity for ppl reading harder passages
- ∴ we revert to more phonological analysis

Fig. 1. A page from a student's lecture notes.

In all of the study group sessions, the participants looked intently at their notebooks as they talked, and also while the other participants talked. The students used the notebooks to recreate the lectures that occurred in class, and when they read from the notebooks it was either a direct quotation of the professor's comments as transcribed by the student, or a

reconstruction of the professor's comments based on abbreviated notes or diagrams. These quotations and reconstructions then served as a prompt for discussion. Thus, much of their discourse was mediated by the external representations in the notebooks.

We chose to videotape the first study session for the second exam, after the group had already completed two sessions in advance of the first exam. The second author arrived early to set up the camera in the dorm common room. In this same semester, the second author was taking a seminar in conversation analysis from the first author, and the participants were told that the videotape was for a course assignment that required an analysis of "naturally occurring conversation." This session lasted a little over an hour; we focus on just under 12 minutes of conversation that took place toward the beginning of the session. We excerpted 12 minutes from this session of an activity that was representative of the group's practice.

In a sense, the lecture notes represent the disembodied voice of the professor, and these representations play a key role in the discourse (Kelly et al., 2001, p. 154). We refer to the conversation concerning each experiment or theory as a *topic unit*, and the 12 minutes analyzed contain four topic units of varying duration. For example, the first few lines that we analyzed comprise the first topic unit, Healy's Unitization Hypothesis. Following that, the students discuss LaBerge and Samuels' model, and they later review the Hardyck and Petrinovich experiment and the Schneider and Shiffman study.

Our analysis revealed two types of talk during the study group session. In *conversational talk*, all students look up from their notebooks and engage in face-to-face conversation. In *mediated talk*—which appears in our transcripts in italics—all students are looking intently at their notebooks while they talk. Because mediated talk is often read from the students' lecture notes, it tends to be in a more formal rather than conversational style, and as a direct quotation it represents the voice of the professor. Teacher style talk has been referred to as "authoritative," using Bakhtin's (1981, 1986) term to contrast teacher style with everyday conversation (Forman, McCormick, & Donato, 1998), and these direct quotations have more of the characteristics of teacher style talk.

When a speaker was engaged in mediated talk, the other participants also looked at their notebooks for the majority of the time, only rarely looking up at the speaker. Yet even though they were looking down, listeners could tell when a speaker looked up from his or her notebook; they attended to the speaker's gaze with peripheral vision, and could hear the tone quality of the speaker's voice change when the voice began to project outward rather than down. When a speaker looked up from the notebook, the other students immediately looked up from their own notebooks to meet the speaker's gaze.

Conversation research has repeatedly demonstrated the importance of eye gaze in managing turn-taking and speaking rights (Goodwin, 1981; Kendon, 1990; Levinson, 1988; Viechnicki, 1997). Participants in a wide variety of discourse settings rely on eye gaze of both speaker and listeners for a wide range of information: speakers monitor eye gaze to determine whether or not the audience is paying attention, or to emphasize critical points; listeners monitor speaker eye gaze to determine when a turn is nearing completion, or to indicate interest or disinterest.

Although we have defined mediated talk as downward eye gaze, discourse can continue to be indirectly mediated by the notebook representations even when speakers are not looking directly at their notebooks. Thus, our definition of mediated talk is not identical with similar discourse notions such as "authoritative speech" or "scientific genre"; however,

in most cases, mediated talk is more scientific and more authoritative than conversational talk, because it is more likely to be a direct quotation from the instructor. And as the transcript shows, these students rarely speak in an authoritative style when they are not looking at the notebooks. The participating author reports that this is a shared aspect of peer culture at this university—an avoidance of authoritative speech, when speaking in one's own voice, reinforces an egalitarian peer culture, one in which all students are learning together.

### 3. Results

The group's collaboration was similar to highly effective collaborating university groups as documented by Fisher (1996); by this third session, participants had established implicit agreement on discussion norms and group goals. For example, the students shared a general goal that the study group session should enhance their understanding of the material. Yet their conversation was not guided by a fixed plan; rather, the group collaboratively improvised their discussion. The following analyses demonstrate that the four students' notebooks were important scaffolds for collaborative learning. Most of the talk was mediated: 7 min and 15 s, whereas 4 min and 30 s was conversational talk. By using conversation analytic methodology, we closely examined the 12-minute transcript to determine the pedagogical impact of the notebooks on the group's collaborative discourse. We group our results into four categories. First, we identify a range of specific microinteractional differences in the turn-by-turn dynamics of mediated talk and conversational talk. Second, we identify three functions accomplished when speakers shift their type of talk during an utterance: to signal the completion of a turn, to provide additional truth claims for an utterance, and to scaffold the student's appropriation of the lecture material. Third, we turn to emergent group phenomena, and we identify an emergent group pattern and show how this collectively produced pattern aids in group learning. This pattern is collaboratively emergent and it could not have been identified by focusing on any one participant or any one turn of dialogue. Fourth, we show how this emergent group pattern is used by speakers to manage the overall temporal organization of the study group session.

#### 3.1. *How external representations affect collaborative discourse*

We identified three differences in conversational dynamics between mediated talk and conversational talk. First, mediated talk had less back channeling than conversational talk.<sup>1</sup> Second, during mediated talk there was less overlapping speech, whereas overlapping speech frequently occurred during conversational talk. Third, during mediated talk the participants left longer pauses between turns and within turns than during conversational talk.

First, the amount and types of back channeling that occurred were different. Nonverbal back channeling was defined as a head nod of agreement; verbal back channeling was defined as murmurs of assent and brief comments on the speaker's unfolding utterance,

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<sup>1</sup> "Back channeling" refers to verbal and nonverbal communications made by the listener while the speaker continues talking (Sacks et al., 1974; Yngve, 1970).



Table 1  
Number of instances of back channeling

|                           | Mediated talk (7 min 15 s) | Conversational talk (4 min 30 s) |
|---------------------------|----------------------------|----------------------------------|
| Nonverbal back channeling | 3                          | 12                               |
| Verbal back channeling    | 7                          | 10                               |

such as “oh, yeah” and “sure.” Listeners used back channeling to demonstrate attentiveness, involvement, and alignment with the speaker. There was less back channeling during mediated talk, and in particular, less nonverbal back channeling (see Table 1). During conversational talk, there were over twice as many instances of back channeling, even though significantly less time overall was spent in conversational talk. For example, in the first turn of the transcript, Mary reads from her notes, and during this utterance, no back channeling occurs. Contrast Beth’s turn, of comparable length and content, in (4). Susan and Mary each nod twice during this turn and Mary back channels with the word “yeah” once<sup>2</sup>:

- (4) B: Probably because related to the thing above, umm, we probably see the words like “of” like, a lot, so then it’s auto[matic,] so that’s probably why. (3)  
 S, M: (nod) M: [Yeah.] (nod)  
 S: (nod)

In contrast to Mary’s mediated talk in turn (1), which receives no back channeling, Beth’s conversational talk in turn (4) receives five instances of back channeling.

A similar contrast is found between turns (24) and (25).

- (24) M: I, one thing about this model is it didn’t really explain how automaticity develops, it just ((3)) *and I also have over time, processing automaticity ((10)) children are better still at picking up letters ((3))*  
 (25) S: And they, like, the task where you count the F’s,  
 if you gave that to a [child they] would be better at finding the F’s (8)  
 J, B: (nod) M: [mm hm]

In Mary’s turn (24), which is mostly mediated (including a 10-second segment of unintelligible speech), she receives no back channeling. In contrast, Susan’s conversational talk in turn (25) elicits three instances of back channeling.

<sup>2</sup> In the transcript, text appearing in italic font is mediated talk; it is spoken with the speaker looking at his or her notebook. Text in roman font represents conversational talk; it is spoken while looking at the other group members. Otherwise, transcript notations are those used by Jefferson (Atkinson & Heritage, 1999), and are summarized as follows:

|       |  |
|-------|--|
| []    | overlapping speech   |
| ((x)) | unintelligible speech of <i>x</i> seconds                                |
| (x)   | a pause of <i>x</i> seconds  |
| =     | indicates two turns were spoken together without any pause, or “latched” |
| ,     | a comma indicates a pause of less than one second                        |
| -     | an en-dash at the end of an utterance indicates flat pitch               |

Of course, during mediated talk, nonverbal back channeling would not be effective, because participants are not looking at each other. It makes sense that the group members would use nods more during conversational talk. But it's not immediately clear why participants use less verbal back channeling when the group's talk is mediated. The second author reports that this is the result of a shared group norm that emerged in the previous study group meetings: mediated talk invokes the lecture setting and the voice of the instructor; because it is a direct quotation from the notes, it is usually in a more authoritative voice. In the canonical lecture class, students are not expected to provide back channel cues. In contrast, conversational talk is closer to a natural conversation, in which back channeling is unconsciously and automatically generated.

In a second contrast, we found that overlapping speech served a different function during conversational and mediated talk. Other than back channeling, which we analyzed separately above, there was not much overlapping speech. There are six instances in the transcript, and all of them occurred at turn transitions—three during mediated talk, and three during conversational talk. Conversation analysts have noted that the turn-transition management system is designed to minimize pauses between turns, and they have documented that this incipient design results in frequent overlaps at turn transitions (e.g., Sacks, Schegloff, & Jefferson, 1974). During conversational talk, overlapping speech serves the function of working toward a shared goal, of indicating a group consensus. The speakers are not trying to cut each other off or prevent others from speaking; rather, the overlaps signify joint focus on the task and collaborative intentions (cf. Tannen, 1989). Two of the three examples of overlap during conversational talk occur at the very beginning of the transcript, turns (6–7).

- (6) S: Do you have [this?] (holding up notebook)  
 (7) B: [Here,] I get it. (2) Here, do you have the drawing? (holding up notebook) The letters. . .

In this example, there is one word of overlap at the turn transition. It occurs after Mary states that she does not understand the LaBerge and Samuels model, and Susan and Beth hold up their notebooks and point to a figure they copied from the blackboard during the lecture (as reproduced in the middle of Fig. 1). Note how this collective action demonstrates that the notebook representations are shared, even though students use their own notebooks. Moments later, additional overlaps occur during turns (11) to (13), and these overlaps demonstrate the group's consensus.

- (11) B: *So like the younger you are, the (1) more you're gonna recognize, you're gonna pay more attention to each,* [each step.]  
 (12) S: [So like the] [earlier. . . yeah.]  
 (13) M: [You're not automa]tized-automatized.

In contrast, the three instances of overlapping speech during mediated talk often indicated that the interrupter had a sudden and unexpected realization, and the spontaneity of the insight resulted in the interruption. These interruptions are examples of how collaborative discourse results in a constructive appropriation of material, as students attain sudden realizations that have the feel of a creative insight (Sternberg & Davidson, 1995).

- (46) M: Okay. *Hardyck and Petrinovich- EMG- lower lip, throat, whatever, okay they looked at differences in processing between difficult low frequency words and easy high frequency words, [um-]*
- (47) J: *[Oh,] I figured out for Hea[ly, it]*  
 M: *[What?]*  
 said like heel- think of unit like a heels, a units, and therefore you're better at reading units, you're more automatized=

Prior to turn (46), the group had been discussing mnemonic devices to help pair the name of the researcher with his or her experiment or model. After conversing normally and laughing for a few moments, the group returns to mediated talk when Mary says, "Okay. Hardyck and Petrinovich," the name of the next topic unit. But Jeremy then thinks of a mnemonic device related to the prior topic unit and interrupts Mary in order to share it. The interruption serves the function of implicitly communicating that Jeremy is not quite ready to continue with the next topic unit.

A second example of mediated-talk interruption occurs in turns (87–88).

- (87) B: *So then in the next one, next part, they do, consistent mapping and they find a flat function so the number of trials has nothing to do with (2) re[sponse time the one where]*
- (88) S: *[Oh, wait wait wait]. Is this they always pick it from the same group of letters? =*
- (89) J: *=Yeah, like the targets are a certain [group] of letters and the foils are another group*  
 B: *[Yeah.]*
- of letters and that's consis[tent. (1) Var]ied is not supposed to make targets and foils and*  
 B: *[Yeah-]*  
*that's why you're able to develop automaticity consistent mapping.*
- (90) B: *So then they match the yes, like (3) Why's it automatic? Because they, yeah, they have in their head, like,*

In this example, Susan interrupts Beth's mediated explanation of the Schneider and Shiffman study with a question pertaining to that study. This interruption can be explained in light of Susan's previous several turns (82, 84, and 86), all of which were either questions or unfinished sentences that trailed off. Evidently, Susan was confused about this study and, as Beth explained it, Susan suddenly realized how to connect the discussion with her own memories of the lecture. Her sudden moment of insight caused her to interrupt Beth's explanation; the collaborative discussion enabled Susan to make new connections among concepts. Her interruption sends the message that she is not quite ready to move on.

These mediated mode interruptions were treated as legitimate. They were not challenged by the interrupted speaker, who always readily yielded the floor. All three group members actively participated in addressing the interrupter's new insight, making sure that the interrupter had an accurate understanding before moving on. For example, in (89) above, Jeremy responds immediately to Susan's interruption, and even Beth—who was interrupted—provides supporting back channeling. Even when Beth gets the floor again in (90), she follows up on Susan's interruption rather than returning to her original point. This

Table 2  
Pauses in speech

|                  | Mediated talk (7 min 15 s) | Conversational talk (4 min 30 s) |
|------------------|----------------------------|----------------------------------|
| Number of pauses |                            |                                  |
| Within turns     | 15                         | 4                                |
| Between turns    | 20                         | 3                                |
| Total            | 35                         | 7                                |
| Duration         |                            |                                  |
| Average          | 3.8                        | 2.1                              |
| Longest          | 26                         | 3                                |

Note. All pauses greater than 1 second in length were transcribed. Durations are in seconds.

suggests that everyone understood the importance of the pedagogical work that resulted in the interruption, and that the group shared a norm that this individual pedagogical work is one of the purposes of the group.

A third difference is the number and length of pauses between and within turns (see Table 2). Pauses were more frequent and longer during mediated talk; there were 7 pauses during conversational talk, and 35 during mediated talk. The mean length of the 7 conversational-talk pauses was 2.1 s, while the mean length of the 35 mediated-talk pauses was 3.8 s. The longest conversational-talk pause was 3 s; there were mediated-talk pauses of 26 and 16 s, and many of 4 and 5 s.

An example of frequent and long pauses during mediated talk is found in turns (105–107). Note that a number in single parentheses indicates a pause of that many seconds; for example, turn (105) has a 26-second pause on the second line. If the eye gaze of the group changed during a pause, the length of the pause is given as two numbers, with the italic number representing the length of the pause while eye gaze is down, and the roman number representing the length while eye gaze is up. Susan's turn (107) ends with an 8-second pause, where the first 5 seconds of the pause take place while eye gaze remains down, and the pause continues for 3 more seconds after she looks up.

- (105) M: Okay, could you hold on one second, *I just wanted to read what I have for this*  
*((2)) Umm. . . (26)*  
*Oh, also, parallel search [(2) is] what he was talking about (1)*
- (106) B: *[Right]* *for the consistent mapping. (3)*
- (107) S: *Parallel search is the MARK of automaticity.*  
*Each additional item doesn't cost you anything,*  
*attentio[nally-wise.] (8)*  
M: *[mmm]*

In these three turns of mediated talk, there are five separate pauses totaling almost 40 seconds. Pauses within turns are particularly unusual in conversation because they provide a turn transition opportunity known as a "turn relevant place" (Sacks et al., 1974), and typically another speaker begins a new turn. At no point during conversational talk were there pauses of this frequency and duration; the longest within-turn pause during conversational talk was 2 seconds. Another illustration of consecutive long pauses occurs during the mediated talk of turns (53–55).

- (53) S: *I have that it's in lips, throat, etcetera...*  
           B: (( ))  
           I think they measure like tiny movements in your like vocal tract-  
           [to see if] you're sort of talking to yourself, kind of,  
           M: [*Oh, okay.*]  
           *or something?* (2)
- (54) J: *Let me write this down. (writes)* (4)
- (55) M: *I'm trying to think of ((2))* (5)

In these two excerpts, the students explicitly comment on two of the activities that take place during these long pauses: reading one's notes, and updating and elaborating on one's notes. Mary's comment in turn (105) indicates that she is using the pause to read her notes closely to make sure she understands them fully. Jeremy's comment in turn (54) indicates that he is using the pause to write down a new insight that emerged from the group discussion. However, students only occasionally write during these long pauses. For the most part students are re-reading and thinking deeply about their notes, looking for material they don't understand fully that they can then bring up for group discussion.

During conversational talk, participants have eye contact with one another, and that allows participants to pick up on subtle cues about the pending onset of a turn-relevant place (Goodwin, 1981; Sacks et al., 1974). This eye contact seems to be critical to accomplishing turn transitions with short pauses. During mediated talk, it is more difficult to detect turn-relevant places because nonverbal cues are not available; longer pauses may reflect this ambiguity, and enable the group members to avoid confusion over turn transitions. Another contributing factor is that during mediated talk, each student is concentrating on understanding the notebook material and is less focused on the group. Listeners are attempting to locate in their own notes what the speaker has been saying, reflecting the importance of the notebooks as mediating artifacts.

We have shown that the use of the external representations in the notebooks results in two types of collaborative discourse. During mediated talk, speakers read from their notebooks, and these external representations mediate their discursive interaction. During conversational talk, participants are not directly attending to the notebooks, and instead are gazing at each other; their discursive interaction has more of the characteristics of everyday conversation: verbal and nonverbal back channeling, overlapping speech, and shorter pauses.

### 3.2. *Shifts within a turn*

In Section 3.1, conversation analytic methods allowed us to identify three differences in the discursive processes associated with mediated talk and conversational talk. However, it is not yet clear how these contrasts affect individual and group learning. In the remaining three sections, we examine how alternation between these two types of talk over a sequence of discourse functions to enhance the group's learning.

Occasionally speakers shift from one type of talk to another within a turn; there were 8 instances of shifts from conversational talk to mediated talk, and 15 instances of shifts from mediated talk to conversational talk. These shifts served three distinct interactional and pedagogical functions: (1) both directions of the shift often signaled the end of a turn; (2) a shift from conversational talk to mediated talk served to warrant the ongoing speech;

and (3) a shift from mediated talk to conversational talk allowed the speaker to revoice lecture material in their own words.

The most common function of a shift (11 of the 23 instances) is to signal that the speaker is nearing completion of his or her turn. Conversation analysts have long realized that turn transitions are collectively and jointly managed and negotiated (Sacks et al., 1974). For example, Goodwin (1981) demonstrated that speakers use and attend to eye gaze as they jointly construct turns of talk. The existence of these two types of talk, defined by the presence or absence of eye contact, provides the participants with a technique with which to manage the timing of turn transitions, as in turn (26).

(26) B: *So then if you're given a low frequency word (2) that people who are skilled readers would (2) be better at detecting the letter-*

Having finished reading material from her notes, Beth looks up to speak the end of the phrase in her notes. Looking up serves to signal that she is about to yield the floor, and the other students can detect her shift in head orientation because her voice begins to project outward rather than downward. A similar shift occurs in Susan's turn (72).

(72) S: *They chose visual search as a simple task (6) Okay, so then the first part they would show them a slide with one letter and then they would show them a slide with multiple letters and you just had to press a yes or no button to say if the first letter was on the second [slide or] not.*

Susan's shift in eye gaze is similar to Beth's in (26). In (72), Susan is examining a schematic drawing of the task in her notebook. During the lecture, Susan had drawn a series of squares to represent the slides used in the experiment, with single and multiple letters in the squares, corresponding to the experiment's conditions. In (72), Susan is reconstructing a verbal description of the task that is cued by the schematic depiction. In both (26) and (72), the student looks up at the very end of her turn, as she completes her examination of her notebook passage, and thus serves to signal the onset of a turn-relevant place.

Shifts from conversational to mediated talk often serve this same function of indicating that the speaker is ready to yield the floor. In everyday conversation, speakers often use direct eye gaze to indicate a turn transition, but they rarely do so by looking away; the notebooks thus provide these speakers with a new technique to signal turn transitions. In this technique, speakers voice most of their turn while looking up, and then look down at their notebook just as they are completing their turn, as in (17).

(17) S: *So like the child has to look at-  
has to look at each letter and say okay THIS is an F, this is ((1)), each time. (2)*

However, many of the shifts occur nearer the middle of a turn, and these serve pedagogical, in addition to interactional, functions. Shifts into mediated talk serve to warrant the speaker's otherwise conversational speech, and shifts to conversational talk are used by speakers to help them appropriate the notebook material by revoicing it into their own words.

The second function of a shift is when students shift their gaze to their notebooks to re-ground their speech in scientific language, warranting the claims they are in the process of making in conversational talk. Five of the eight shifts to mediated talk served this function. Both scientists (Latour, 1990) and students (Forman & Ansell, 2002) have been

shown to use external representations to create more authoritative scientific arguments. The notebooks represent the voice of scientific authority because they act as a surrogate for the professor (Kelly et al., 2001); a direct quotation from the notebook adds that authority to the ongoing utterance (Forman et al., 1998), and to some extent, a simple glance at the notebook can invoke that authority. During turns (112) through (118), when Mary is responding to a question from Jeremy, she glances down at her notebook twice during her largely conversational explanation, as in turns (117) and (118):

- (117) M: So like set size doesn't affect reaction time, automatic ((5))  
           J: {writes in notebook as M talks}
- (118) M: (16) *So for instance- but if they took, like, the, constant mapping and, they changed the colors for different letters as the letter reappeared, then the automaticity decreased.*

In turn (117), Mary had been looking at Jeremy, and when she looks down at her notebook at the beginning of (118), it is to confirm that what she has just told Jeremy is correct before she continues. Mary's quick glance at her notebook signals to Jeremy that she has double-checked and is relatively confident in the answer she is providing.

Susan warrants her speech by looking down in turn (23), and Mary executes a similar switch in turn (24) (back channeling removed for readability):

- (23) S: Oh, I think when it's talking about a child who can't read at all and the parents read to them and, soon they learn that when the parent's reading they're looking at the squiggly stuff, not at the pictures to read. [It's just their, their und]- yeah, their understanding that the parents are reading the [words,] that's where they're getting what they're saying from I guess. (4) *And so then when you're a skilled reader, you only direct attention to the fourth box, the meaning. (4)*
- (24) M: I, one thing about this model is it didn't really explain how automaticity develops, it just ((3)) *and I also have over time, processing automaticity ((10)) children are better still at picking up letters ((3))*

In contrast to those shifts that signaled the onset of a turn-relevant place, these shifts typically occur in the middle of a turn rather than at the end, and serve a more substantive function: the speaker uses the shift to provide greater authority to his or her ongoing constructed speech, by indicating that it is not only from memory, but is being drawn directly from the notebooks and represents the voice of the instructor.

The third function of a shift is perhaps the most pedagogically important: Students shift from mediated talk to conversational talk to revoice material in their own words, and this helps students to appropriate the lecture material. Seven of the 15 shifts to conversational talk were of this type. When students quote from the lecture notes they invoke the authoritative voice of the professor. Looking up from the notebooks typically corresponds to a change in voice—from the instructor's voice as encoded in the lecture material, to the student's own voice commenting on that material. Turn (11) demonstrates this revoicing pattern. Beth summarizes the LaBerge and Samuels model, and at the point where she looks up, she begins to revoice what she has already said. She originally begins to quote the lecture notes, which are phrased as an act of recognition, and after looking up, changes her wording to the more colloquial "you're gonna pay more attention." Beth's shift of gaze occurs at the same time that she begins to revoice her lecture notes.





talk potentially supports a learning process in which the group members gradually absorb the material and become less reliant on the notes. The notebook representations function as a scaffold for a collective appropriation of the material; as the group discussion proceeds, the scaffold is needed less and less—the typical pattern of guided participation emphasized by socioculturalists (e.g., Rogoff, 1990, 1998).

Note that this emergent group pattern is parallel to the third within-turn pattern identified in Section 3.2: individual speakers shift from mediated to conversational talk to revoice notebook material. The mediated-to-conversational shift serves a similar function both at the individual level and at the group level; the external representations of the notebooks scaffold both individual learning and collective learning. This is one of the benefits of external representation that have been documented by studies of computer-supported collaborative learning (Crawford et al., 2002; Michalchik et al., 2002; Suthers & Hundhausen, 2002). Yet in this tradition, researchers focus on students' electronic communications as mediated by the software.

### 3.4. *Topic unit transitions*

The order of the topic units corresponds to the mediating structure of the original lectures the professor presented in class, and does not have to be negotiated by the participants. But the decision to move to a new topic unit is a collective decision and the transition must be collaboratively negotiated. This negotiation is grounded in several tacit practices and beliefs. For example, everyone must be ready to move to the next topic unit before the group proceeds, and transitions cannot be imposed by any one speaker, but rather must emerge from a collective decision-making process.

The first topic unit transition comes in turn (5).

- (4) B: Probably because related to the thing above, umm, we probably see the words like "of" like, a lot, so then it's auto[matic,] so that's probably why. (3)  
 S, M: (nod) M: [Yeah.] (nod)  
 S: (nod)
- (5) M: *So, then I have LaBerge and Samuels, um, model directed at understanding how children learn to read.*

After Beth's turn (4), during which she receives back channeling indicating understanding and agreement, there is a 3-second pause. Mary apparently interprets this pause to mean that no one has anything further to say about the first topic unit—the Healy Unitization Hypothesis—and she initiates a transition by saying, "So, then I have LaBerge and Samuels. . ." This is mediated talk: Mary is looking down and reading from her notebook. Because of the emergent group pattern identified in Section 3.3—each topic unit ends with conversational talk—looking down at the notebooks after having been engaged in conversational talk sends an implicit message to the other group members that one is ready to transition to the next topic unit. During turn (4), the group was engaged in conversational talk; after a 3-second pause, Susan and Mary have shifted their gaze down at their notebooks. The pause, and the redirection of gaze, are collective group processes that accomplish the collective work of indicating that the members of the group are ready for the next topic. This implicit metatalk reinforces Mary's explicit naming of the next topic unit.

The next change of topic unit, to the Hardyck and Petrinovich study, again shows the collaborative and emergent nature of transitions; unlike the first, it takes several turns of negotiation before the group reaches the necessary consensus to move forward. First, Mary attempts to change topic units in turn (42), but is not successful.

(42) M: *Okay, um=*

(43) B: *=So that works, I'll just think of beer.*

Mary's aborted turn (42) can be interpreted as a bid to change the topic because it is a shift to mediated talk after a long stretch of conversational talk. Yet Mary is interrupted by Beth. Mary's second attempt—again using mediated talk—lasts longer, but she is once again interrupted:

(46) M: *Okay. Hardyck and Petrinovich, EMG, lower lip, throat, whatever, okay they looked at differences in processing between difficult low frequency words and easy high frequency words, [um-]*

(47) J: *[Oh,] I figured out for Hea[ly, it] said*  
*M: [What?]*

*like heel, think of unit like a heels, a units, and therefore you're better at reading units, you're more automatized=*

After Jeremy's interruption—indicating that he is not finished talking about the last topic unit—Mary tries for a third time to transition to the Hardyck and Petrinovich study, again using mediated talk.

(52) M: *Okay, Hardyck and Petrinovich, thank you for ((count[ing.]))*

*J: [mm hm]*

*They looked at differences in processing between difficult low frequency words and easy high frequency words. So, EMG. Which, what's EMG?*

In contrast to this extended negotiation of the transition to the third topic unit, the transition to the fourth topic unit occurred quickly, indicating that the group had already come to a shared understanding that the third topic unit was complete:

(66) J: *Yeah, just yeah just how we sound it out (4)*

*M: (nod)*

(67) M: *Schneider and Shiffman?*

(68) S: *Schneider and Shiffman.*

After the group had reached understanding about the Hardyck and Petrinovich study, (indicated by many participants saying “yeah” and nodding in turns (63–66)), Mary, after a 4-second pause, initiates the change by saying “Schneider and Shiffman?” Unlike Mary's other bids to move to the next topic unit, this one is conversational talk. Her questioning prosody gives this bid a more explicit metatalk flavor than the other transition bids, which instead had the flat prosody of statements. Susan affirms “Schneider and Shiffman” and the transition is complete.

It is interesting that almost none of the topic unit transitions was accomplished using explicit metatalk, because in many everyday conversations topic transitions are explicitly signaled and discussed (Schiffrin, 1980). Instead of using explicit metatalk to initiate topic transitions, the participants make use of the affordances provided by the two types of talk, and they take advantage of the emergent group pattern identified in Section 3.3: a topic unit

always begins with mediated talk, and then gradually changes to predominantly conversational talk. Because the participants are at least subconsciously aware of this emergent pattern, participants can implicitly initiate a topic transition simply by shifting to mediated talk.

#### 4. Conclusion

In this paper we examined collaborative discourse in an informal, student-managed study group of four college students. Our goal was to better understand how collaboration works by using conversation analysis to analyze the processes of individual and group learning. Our empirical method resulted in findings that extend educational research in four ways.

First, we focused on the conversation of peer groups with no teacher present. Several decades of research into cooperative groups has proven that peer groups contribute to learning. However, unlike more recent sociocultural approaches, this tradition has not examined the conversational dynamics of these groups; studies of cooperative learning primarily focus on individual outcomes, task structures, and incentive structures (e.g., [Slavin, 1990](#)), what [Kelly and Crawford \(1997\)](#) referred to as “second order” studies (p. 534). On the other hand, sociocultural studies of classroom discourse have tended to focus on teacher–student conversation. As a result, there have been few studies of the discourse processes of collaborative peer groups, and few studies that have attempted to identify which features of conversation are associated with the most effective collaboration. Our study demonstrates how conversation analysis can allow us to look inside the “black box” of collaboration ([Bossert, 1988–1989](#)) to identify specific discourse processes that make collaboration a uniquely effective learning environment. The discursive phenomena that we identified are fundamentally interactional and collaborative, and would be difficult to identify if one coded only individual turns of speakers, in isolation from the unfolding stream of discourse. The findings that we summarize below demonstrate the potential value of conversation analytic methods for studies of educational collaboration.

Second, we demonstrated the interactional mechanics whereby external representations affect discourse processes and learning. Recent studies of scientific and mathematic classroom discourse have discovered the important educational role played by representations. Our study extends this work by examining how the discourse processes of the group are mediated by these representations. The notebooks acted as scaffolds that guided the group’s activity, and this guided participation allowed the group to attain a higher level of shared focus and intersubjectivity. We found that during much of the discussion, students talked while they each individually looked at their own lecture notes. These external representations allowed participants to negotiate differences of interpretation, and supported them in the important collaborative tasks of asking clarifying questions and providing elaborated explanations. By analyzing detailed transcripts of the collaboration, we identified several aspects of the discourse that were affected by the use of the notebooks—such as the amount of interruption and overlapping speech, the shift from direct quotation to paraphrasing and revoicing, the use of notebooks to warrant a developing position, and the overall flow of and transitions between topics.

Many researchers have examined how different forms of representation—for example, text or graphics—differentially affect the effectiveness of collaboration (Sfard & McClain, 2002; Suthers & Hundhausen, 2002). Our study extends this work by using the techniques of conversation analysis to examine how collaborative conversation itself changes in the presence of mediating artifacts. This focus allowed us to identify an emergent group-level process of guided participation—where the external representation is gradually used less and less, as students increasingly revoice and appropriate the information.

Third, we examined collaborative emergence over extended sequences of discourse. Beginning in the late 1990s, studies of science, math, and literacy education have increasingly examined the conversational dynamics of educational classroom talk. Yet most of these studies have focused on relatively brief exchanges no more than a minute in length. We extend this work by examining the longer-term emergent patterning of educational talk. For example, in Section 3.3 we showed that in our study group, the students always engaged in a period of mediated talk on a given topic before they engaged in conversational talk on that same topic. This pattern collaboratively emerged from the group's conversation, and it became an important element contributing to the educational value of collaboration. Because mediated talk and conversational talk work together to support collaborative dialogue, a group that remains task-focused and mediated for the entire session might be a less effective study group. Non-mediated talk cannot be dismissed as “off task” because it often plays an essential metatalk function of shaping the direction and pace of the task-focused interactions (Gumperz & Field, 1995; Stokoe, 2000; Tannock, 1998).

Fourth, we argued that these emergent patterns are a concrete manifestation of the “group learning” theorized by socioculturalists, and we showed the detailed mechanics of how these emergent patterns can contribute to individual learning. Very few studies have examined how collective group phenomena emerge from extended sequences of discourse, and how these unintended emergent effects might then contribute to learning; rather, most studies of classroom discourse have examined the knowledge that students are meant to learn, often by focusing on individual students in the classroom. Our study has extended this work by examining how discourse contributes to both social and individual learning, as norms and patterns collaboratively emerge and then act as scaffolds for learning. For example, in Section 3.2 we showed that a speaker sometimes begins talking while reading from the notebook, invoking the instructor's voice, and then looks up to revoice the material in his or her own words. This individual pattern replicates the emergent group pattern of Section 3.3, as predicted by sociocultural theory. This shift between types of talk served as an interactional technique that scaffolded students in their appropriation of the lecture material. The fact that this sequential pattern is reproduced on both the individual and the group level suggests that external representations may help to guide both individual learning and group learning. Our analyses support the sociocultural claims that learning is both an individual and a group process, and that a full explanation of learning requires a simultaneous examination of both individual and social processes (Cobb, Jaworski, & Presmeg, 1996; Saxe, 2002). Our analyses demonstrate the potential benefits of merging socioculturalism and conversation analysis to study the social construction of knowledge (Forman & McCormick, 1995; Gee & Green, 1998).

In sum, we analyzed collaborative discourse in a group that used external representations, and by doing so, we hope to contribute to the understanding of how collaboration enhances

learning. Although we analyzed a college study group, our goal has been broader—to show how language functions as a cultural and psychological tool for learning. Future studies of collaborating groups should incorporate close studies of the discourse processes of these groups, and should examine the emergence of collective group patterns over extended sequences of discourse. Such studies would be an elaboration of the sociocultural emphasis on the importance of discourse and social and cultural context in learning (e.g., Forman, 1996; Gee & Green, 1998; Hicks, 1995), and would be complementary with those studies of cooperative learning that primarily focus on individual outcomes, task structures, and incentive structures (e.g., Slavin, 1990). Future studies of the role played by external representations should likewise examine how discourse results in emergent group patterns, and should carefully examine how these representations affect the moment-to-moment unfolding of individual and group learning. Such research has the potential to bring together these several recent complementary strands of research to form a unified study of educational collaboration.

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