Commentary

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Unresolved Contradiction as a Condition for Promoting Socially Mediated Learning

Commentary on Howe

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Knowledge growth · Socially mediated learning · Unresolved contradiction

In 'Collaborative group work in middle childhood: Joint construction, unresolved contradiction and the growth of knowledge,' Howe [this issue] addressed what appears to be a central, but often untested, assumption in the literature on effects of collaboration on learning; namely, that knowledge growth is achieved (primarily) through one of two means: assimilation of a relatively advanced contribution proposed by one child because it is accepted whole by others (what she refers to as type 2 joint constructions); or assimilation of a joint construction developed in a coordinated fashion by multiple children that results in a relatively advanced whole (type 1). The author considered as a plausible alternative that individual learning from collaboration can be mediated by unresolved contradiction, and this may, in the end, offer a simpler explanation than previous accounts. Reanalysis from three domains of scientific experimentation (motion, cooling, and floatation) provided ample evidence for the plausibility of an account based on unresolved contradiction. Specifically, there were statistically significant correlations between unresolved contradictions and gains from pretest to delayed posttests. The absence of an effect for immediate posttest performance, and its presence in the delayed testing condition reinforced the claim that postgroup processes are at work in fostering conceptual development. Though the specific causal chain cannot be established from this study, this work provides a promising evidentiary base for the hypothesis that the processes by which collaborative experiences operate upon and transform the knowledge of individuals is mediated by unresolved contradictions rather than the assimilation of joint constructions.

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Applying Howe's Framework of Unresolved Contradiction

Howe drew on data from contradictions that arose in the course of science lessons to provide evidence for her claims. Testing the hypothesis using data from a mathematics class is useful since it provides the added element of externalized (reified) representations of structures and procedures. If Howe's claim holds, then even in the face of controversy there should be evidence of conceptual growth. The data offered here are in the realm of mathematical reasoning among middle school students in the USA (sixth graders, ages 11–12 years old). Though individual learning was not assessed for this lesson (the pre- and posttests were administered at a more coarse grain than this individual class session), profound changes in nature of the group interactions in the face of unresolved contradiction necessitate a re-examination of the process in light of Howe's ideas.

The methodological details are presented elsewhere [Nathan, Eilam, & Kim, 2007]. Briefly, an entire class (n = 24) spent over 1 h of a double-length mathematics class collaborating on a spatial reasoning task posed by one of the students: *How do you cut a pie into eight equal-sized pieces making only three cuts?* During this time, students were observed working out their ideas using drawings, manipulatives, constructions, hand gestures, and, of course, language to publicly present and then critique one another's proposals for solving the Pie Problem.

The transcript of the Pie Problem discussion showed an unresolved contradiction. Whereas some students (those with a *geometric view* of the problem) were willing to entertain a horizontal slice (parallel to the table top) as a legitimate cut, thus producing eight equal-sized pieces from a previously quartered pie, others (those with a *literal view* of the problem) believed that this slice violated the integrity of the pie, and would normally be considered both socially and aesthetically unacceptable. As one child with a literal view put it, 'the thing would like fall off and like I think it's just weird that you cut it through the middle.' In contrast, a child with a geometric view defended the move, stating 'This is just a demonstration of, like, how you'd see it from that perspective.' As if to further demonstrate the abstract manner that characterized the view held by those in the geometric group, one student made a comment about the whole problem-solving endeavor, 'It's just a diagram. I mean nobody's just going to come up here and eat the dry-erase board.'

The Pie Problem revealed the central influence on the collaboration of these two distinct camps, with over 90% of the 46 proposed solutions attributable to one or the other. Detailed analyses of the ensuing discourse showed that the viewpoints of the two groups did not converge, and no students were observed switching camps. These were firmly rooted and distinct *frames* [Bateson, 1972] or *genres* [Bakhtin, 1990] that influenced the very nature of students' perceptions of the problem and the criteria upon which proposed solutions were evaluated.

It might seem that this would be the basis for an unproductive setting, but that was hardly the case. In fact, analyses over time of the composition and quality of the solution representations revealed a striking pattern. Solution representations were rated by the research team based on the degree to which they addressed three criteria: (1) adherence to the principles of perspective geometry (external consistency); (2) uniformity with which elements of the representation took on certain meaning or roles in the solution (internal consistency), such as whether a drawn line represented an edge in part of the solution but a cut in another, and (3) the effort and

elaboration needed to interpret the drawing in an unambiguous manner (ambiguity). The rating system helped to expose the progression in representation use.

Over time, students in both camps proposed representations that successively showed greater consistency and less ambiguity. For example, out of 46 solution representations generated by students in about an hour, the lowest level, most idiosyncratic representations dominated the first half of the discourse. In contrast, representations that were less ambiguous, more standardized, and more evocative of the three and four dimensions that factored into the solution were most common in the latter half of the discourse. Indeed, there were no representations with the highest rating level presented during the first 45 min of the class discussion; all of the highest rated representations (n = 5) were presented in the final 15 min of the discussion. Statistically, it was significantly more likely for students' solution representations to receive higher ratings in the second half of the discourse than the first half [$t(40) = 3.27$, MS = 0.35, $p < 0.005$]. This growth in the informativeness of the solutions and their clarity occurred despite – or perhaps, as Howe might claim, *because* of – insurmountable differences between those who exhibited a literal interpretation of the Pie Problem, and those who exhibited a geometric view.

The analysis of the transcript also suggests a cause: students' motivations to establish intersubjective meaning with one another led to the successive refinements of the solutions. Participants (students and the teacher) were continually commenting on proposed solutions in order to ascertain their meaning. The structure of the discourse was fairly consistent. First, there was an initiation to speak, most often posed by the teacher. If that initiation was a closed, or known-answer question (these occurred only 5% of the time), the student would respond in a direct manner, as is typical of Initiation-Response-Evaluation sequences [Mehan, 1979]. If the invitation was open (open I-events, such as 'Let's listen to Bob now please,' were observed 78.6% of the time), students usually took a protracted turn-at-talk that often involved the demonstration or modification (what came to be labeled D-events) of a publicized representation, presented physically, graphically, or verbally. Then students, rather than the teacher, tended to provide an evaluation and elaboration (E-events) of the student solution demonstrations. Because of the highly student-directed nature of some of the sequences, often seeded by an open initiation from the teacher, these were labeled Initiation-Demonstration-Evaluation (IDE) sequences [Nathan et al., 2007]. IDE sequences, along with the rich demonstration phases that provided voice to students' solution representations, were the most frequent triads for this classroom discussion (77.8%) and occupied the majority of the class time (84.3%) that was devoted to the Pie Problem.

Even more striking, statements about intersubjectivity served as reliable markers for the occurrence of the next IDE sequence. This analysis operated with a *participatory view* of intersubjectivity, where both consensual agreement and disagreement are regarded as aspects of a common set of processes that mediate collective activity [Matusov, 1996]. Interlocutors do not have to reach consensus or converge on a common solution to exhibit intersubjectivity. Rather, conflicts, centered on a common set of ideas, would also indicate intersubjective understanding. In fact, it appears that a substantial degree of shared understanding was necessary to express substantive disagreement through divergent views. Both convergent (positive intersubjectivity, IS+) and divergent (negative intersubjectivity, IS–) statements were identified, and utterances frequently included both forms. IS+ was coded when a common frame of reference, such as speaking about a common representation or

stating agreement was in evidence. IS– was coded when participants offered alternative interpretations, confusion, or outright disagreement, so long as it was attributable to a common referent. When the pattern of intersubjectivity occurrence was analyzed, IDE sequences were led by a statement expressing either positive (agreeable) or negative (critical) intersubjectivity 88% of the time. The vast majority of the time (85%), these included negative statements of intersubjectivity. Statements of intersubjectivity, in effect, became prompts for participants to refine or propose new solutions that would respond to challenges made in previous statements.

Assessing the Unresolved Contradictions Hypothesis

The patterns within these data appear to be consistent with the unresolved contradictions hypothesis. Although these data are different from those used by Howe, and do not draw on pretest, posttest gains, there is evidence in the discourse that the conflicting frames of interpretation among students prompted them to refine their solutions. The changes observed in the types of representations used actually provided a form of convergence not evident at the level of specific solutions. This was a convergence on a shared set of norms for what constituted an appropriate representation. While students in opposing camps did not achieve agreement, the conflicting viewpoints led students to express their divergent views in more refined ways.

Several possibilities emerge from examining the Pie Problem data using Howe's perspective that may suggest fruitful directions for future research. First, it is useful to examine the evolution of the characteristics of the solutions offered by students as a way to identify how collaboration and contradiction may foster changes in the discourse. Second, identifying differences in students' interpretive frames is of importance, since this can affect what will be regarded as appropriate or inappropriate ideas. Third, tracking the role of intersubjectivity may prove useful for elaborating on the influential processes at work during student collaboration. Howe's use of 'successive contradiction' and 'total contradiction' provides natural places where intersubjective analyses could be expanded. Fourth, analyses at the discourse level provide a rich complement to the quantitative analyses that frame this work to date.

A final thought that transcends both the Howe data and data from the Pie Problem is offered regarding the nature of immediate or delayed effects. Research on learning from text (another form or discourse [van Dijk & Kintsch, 1983]) has shown that some learning shows up on immediate tests of knowledge and recall while other forms do not show up immediately but are evident after a moderate delay (hours to weeks). Generally, changes in one's mental model of the topic under investigation are often not revealed until much later, where they exert greater influence on one's judgments [Anderson & Thiede, 2008]. It is as though an integrative process or set of processes is needed before showing up as changes in one's reasoning, as reflected in test performance.

In sum, Howe offers a strong argument on both theoretical and empirical grounds, with appropriate qualifications of the provisional nature of the claims, that unresolved contradictions may offer a better and more parsimonious model than one of joint collaboration. It serves as a useful perspective on the complex interactions that arise during group work and other forms, and has the potential to serve as a valuable framework for many future studies of socially mediated learning to come.

References

Anderson, M.C.M., & Thiede, K.W. (2008). Why do delayed summaries improve metacomprehension accuracy? *Acta Psychologica, 128*, 110–118.

Bakhtin, M.M. (1990). *Art and answerability: Early philosophical essays.* Austin: University of Texas Press.

Bateson, G. (1972). A theory of play and fantasy. In G. Bateson (Ed.), *Steps to an ecology of mind: A revolutionary approach to man's understanding of himself* (pp. 177–193). New York: Ballantine.

Matusov, E. (1996). Intersubjectivity without agreement. *Mind, Culture, and Activity, 3*, 25–45.

Mehan, H. (1979). *Learning lessons: Social organization in the classroom.* Cambridge: Harvard University Press.

Nathan, M.J., Eilam, B., & Kim, S. (2007). To disagree, we must also agree: How intersubjectivity structures and perpetuates discourse in a mathematics classroom. *Journal of the Learning Sciences, 16,* 525–565.

van Dijk, T., & Kintsch, W. (1983). *Strategies of discourse comprehension.* New York: Academic Press.