13 2 4

5

6

7 8

Attending to others' posts in asynchronous discussions: Learners' online "listening" and its relationship to speaking

Alyssa Friend Wise • Simone Nicole Hausknecht • Yuting Zhao

 Received: 22 August 2013 / Accepted: 21 March 2014
 9

 © International Society of the Learning Sciences, Inc. and Springer Science+Business Media New York 2014
 10

11 Abstract Theoretical models of collaborative learning through online discussions presuppose 12 02 that students generally attend to others' posts. However, a succession of studies over the last 13 decade has shown this assumption to be unwarranted. Instead, research indicates that learners 14attend to others' posts in diverse and particular ways—an activity we have conceptualized as 15online "listening." In this study, we take an important step forward in developing a robust 16 theory of online listening by examining the relationship between how learners "listen" (access 17existing posts) and "speak" (contribute posts) in online discussions. Ten variables indexing 18four dimensions of students' listening (breadth, depth, temporal contiguity and revisitation) 19and five variables indexing three dimensions of students' speaking (discursiveness, depth of 20content and reflectivity) were calculated for 31 students participating in 6 week-long online 21discussions as part of an undergraduate educational psychology course. Multi-level mixed-22model linear regressions indicated that responsiveness of students' posts was positively 23predicted by how often they revisited previously read peer posts, and negatively related to a 24greater number of posts in the discussion overall. The depth of posts' contents was predicted 25by the percentage of posts viewed that students actually read (as opposed to scanned). An 26exploratory follow-up analysis indicated that these listening-speaking relationships manifest 27differently over time for distinct subsets of learners (e.g., a decrease in variable pairs versus 28corresponding fluctuations around stable levels). Put together, results suggest that when 29students take the time to read and re-read their peers' posts there are related benefits in the 30 quality of the posts they contribute. 31

KeywordsAsynchronous discussion groups · Online learning · Student participation ·32Computer mediated communication33

34

A. F. Wise • S. N. Hausknecht • Y. Zhao Simon Fraser University, Surrey, BC, Canada

A.F. Wise (🖂)

Faculty of Education, Simon Fraser University, 250-1345 102nd Avenue, Surrey, BC, Canada V3T 0A3 e-mail: afw3@sfu.ca

Introduction

35

Asynchronous discussions are often seen as a powerful venue for knowledge construction due 36 to their affordances for thoughtful commentary and reflective responses (Lipponen 2002). The 37 core premise is that learners build their ideas collectively and individually through dialogue; 38 thus, well-designed and supported online discussions can contribute to learning. Various 39 mechanisms have been proposed to explain such learning, including the act of articulating 40one's ideas, receiving feedback on these, the socio-cognitive conflict caused by exposure to 41 divergent views, the taking of multiple perspectives into account, and the internalization of 42collaborative activity (Stahl 2005; Lipponen 2002). In common, all depend on two basic 43interrelated activities that learners must engage in: contributing posts to the discussion, and 44 accessing existing posts (Wise et al. 2013a). When learning discussions are truly collaborative, 45these two activities are intimately related and inform each other. In contrast, if learners do not 46attend to others' posts (or do so in unproductive ways) the communication that results may be 47 shallow and disjointed (Thomas 2002; Webb et al. 2004) and more accurately characterized as 48 a series of parallel monologues rather than a true discussion. 49

Many studies of computer-supported collaborative learning have examined how students 50contribute to online discussions, inspecting in detail the comments they make and how 51subsequent posts relate to prior ones (e.g., Hew et al. 2008; Suthers et al. 2010; Pena-Shaff 52and Nicholls 2004). However, the other half of the process is often taken for granted-that is, it 53is assumed that students are generally attending to others' posts. This is important because it is 54a critical link in the logical chain by which the meaning of references between posts is 55interpreted. Specifically, there is a tacit presumption that the threads of conversation picked 56up and expanded on are chosen purposefully. In other words, the posts responded to are 57inferred to be *selected* for some reason out of the full set of existing posts. 58

However, a succession of studies over the last decade has shown these assumptions to be 59unwarranted (Hewitt 2003; Peters and Hewitt 2010; Palmer et al. 2008; Dennen 2008; Brooks 60 **O3** et al. 2013; Thomas 2002). Specifically, examination of overall student reading patterns has 61 suggested generally limited and shallow engagement with previous discussion posts (Hewitt 62 2003; Palmer et al. 2008; Brooks et al. 2013). Students often attend to their peers' posts very 63 briefly, simply scanning the contents before moving on (Peters and Hewitt 2010), and they 64 rarely return to view a post a second time (Hewitt 2005). Some messages posted to a 65discussion are never even viewed by any students at all (Thomas 2002). 66

This evidence initially suggested the converse of the original presumption of attention to 67 others' posts: that, in fact, students generally disregard their peers' comments. This would pose 68 a serious problem for online discussions as a medium for computer-supported *collaborative* 69 learning. However, the above-mentioned studies did not investigate differences across stu-70dents; thus, instead of universally low attention, it is possible that some learners attend to 71others' posts more than others. Our recent work (Wise et al. 2012a, c, d, 2013a) described in 72detail below, has documented that indeed students attend to each other's posts in diverse ways, 73many of which are not disregardful. More importantly, an online discussion is not a single 74entity to which a learner simply does or does not attend. It is an ever-growing collection of 75multiple posts, often related to each other in complex structures. Thus, the critical question to 76be concerned with is not simply *whether* students attend to others' posts in a discussion or not, 77 but how they do so. 78

Over the past 4 years we have developed a research program examining the different ways students do (and do not) attend to others' posts in online discussions. In considering this collection of behaviors as part of meaningful activity within online discussions and a critical part of the knowledge construction process, we have offered the term "online listening" to 82

Intern. J. Comput.-Support. Collab. Learn.

move the discourse away from prior language that is either overly generic ("reading") or passive and pejorative in nature ("lurking"). A further explanation of how we conceptualize online listening and differentiate it from these prior terms is provided in the following section.

While our work examining students' online listening behaviors has documented the rich 86 and varied patterns of attention to existing posts that lie under the surface of online discussions 87 (e.g., Wise et al. 2012a, b, c), it has not yet connected such behaviors to the ways students 88 contribute to the discussions. Some listening behaviors seem intuitively more desirable than 89 others (e.g., attending to a large rather than small number of discussion posts); however, 90 among the diverse patterns found it is not always clear which behaviors are most productive 91and should be encouraged. For example, is it more beneficial for students to log-in frequently 92but relatively briefly, or in a smaller number of extended sessions? Even when a listening 93 behavior appears theoretically advantageous for discussion, it is important to specifically 94articulate how the particular behavior is thought to contribute to "better" discussion processes 95and to test these propositions empirically. Thus connecting students' listening behaviors to 96 their discussion contributions (i.e., "speaking" behaviors, as explained further below) is critical 97 to developing a robust theory of online listening. In this paper we begin to bridge this gap by 98examining the relationship between students' online listening and speaking activities. 99

Conceptualizing listening in online discussions

Online listening: definition and characteristics

We have coined the term online listening behaviors in reference to the ways students attend to 102each other's posts in online discussions in order to leverage the conceptual similarities between 103the act of attending to others' comments in this digital context and that of listening (auditorily) 104in face-to-face discussions. We argue that this is useful because the purpose and many of the 105properties of the activity of listening in aural and written discussions are fundamentally the 106 same. While there are certainly also differences (discussed below), using the metaphorical 107notion of listening to refer to the ways in which students attend to each other's posts in an 108online discussion gives us a conceptual entrée to language that considers attention to others' 109posts as an integral and productive part of discussion activity. 110

To begin, "listening" in a discussion, both online and face-to-face is the activity of attending 111 to the ideas of another individual that have been externalized through language. Different from 112the physiological processes of hearing words that have been spoken or seeing words written on 113a screen (the biological mechanisms through which the externalizations of language are 114received), *listening* is a complex cognitive activity involving numerous mental processes 115and decisions (Strother 1987; Burleson 2011). That is to say, listening is an active, rather than 116passive activity that includes elements of processing another's ideas. Importantly, prior 117experiences will influence how an individual listens to particular messages, thus different 118 people can perceive the same message in different ways (Bodie et al. 2008). Additionally, the 119120idea of listening to (as opposed to simply hearing) a message connotes a certain amount of openness to considering ideas, beliefs and values that may conflict with one's own (Garrison 1211996). Such dissonant views can be attended to in a variety of ways, such as simply attempting 122to comprehend the comment or critically examining what has been said. Importantly, in the 123specific context of a discussion (whether online or face-to-face), listening is not an isolated 124125endeavor, but an integral component of the larger activity of giving, receiving, negotiating, building on, and challenging others' ideas. Thus, the purpose of listening and the way one 126engages in it go beyond the simple reception and consideration of others' ideas to that of 127

formulating a contribution. In this sense, listening in a discussion makes an important128contribution to speaking by supporting subsequent comments that relate to those already129made. Particularly, for online discussions in an educational context, this is critical in supporting130learning because it is through the exchange of ideas and negotiation of meaning with others131that collaborative learning is thought to occur (Pena-Shaff and Nicholls 2004).132

We have detailed the ways in which the purpose and fundamental properties of listening are 133the same in discussions conducted face-to-face or online. However, there are also important 134differences. One of the main characteristics of online discussions that has notable implications 135for listening is their asynchronous temporality (Wise et al. 2013c). Specifically, in online 136listening, learners are not constrained by the timeline in which comments are made (Jonassen 137and Kwon 2001); thus they can attend to the text-based expressions of others' ideas when, for 138 how long, and which order they choose. In addition, online discussions are generally 139threaded—meaning that a conversation can branch off in multiple directions. These features 140give learners a larger decision space related to listening and thus a greater range of possible 141 behaviors. As learners choose to attend to different posts, at different times, and in varying 142orders, they each listen to the same conversation in different ways. In other words, contrary to 143a face-to-face discussion, online discussants each have their own unique listening timeline 144rather than a communal one (Wise et al. 2013c). For example, a learner may choose to log-in to 145a discussion frequently, attending to single comments as they are made, or they might engage 146in fewer, but longer sessions, attending to a group of comments in a particular thread regardless 147of when they were contributed. Similarly, learners have control of for how long they attend to 148each post, practically manifested as reading or scanning posts (Hewitt et al. 2007). They are 149also able to take as much time as they need to consider the existing comments before 150composing a response (Harasim 2000). In addition, asynchronous online discussions allow 151learners to easily re-attend to comments they found particularly interesting, important or 152confusing. However, as the listening decision space becomes larger, certain difficulties also 153arise. For example, students report feeling overwhelmed and not knowing where to start when 154they encounter a voluminous or heavily branched discussion (Peters and Hewitt 2010). As a 155result, their listening decisions may be driven by efficiency, coping strategies or superficial 156features of the discussion interface (Wise et al. 2012c). 157

In summary, the notion of online listening is useful in conceptualizing how learners' attend 158 to other's comments as an active, individually-driven and integral part of online discussion participation. In the following sections we highlight specific differences and advantages of the 160 notion of online listening over previous terminology. 161

Why listening rather than "lurking" or "reading"

Some prior work examining how people attend to others' contributions in online spaces has163referred to this process as "lurking" and those who engage in it as "lurkers" (Nonnecke et al.1642004; Rafaeli et al. 2004). While such work has been useful in bringing to light previously165unexamined online activity, we find the term "lurker" problematic in several ways when166referring comprehensively to how people attend to other's posts in online discussions.167

First, a lurker is generally thought of as someone who accesses an online discussion, but 168 does not contribute or become "actively involved" (Preece et al. 2004). Immediately, this 169 creates difficulties since it implies that attending to others' posts is a passive activity requiring 170 little cognition or decision making. It also isolates the activity of accessing posts from that of 171 making them, ignoring the important interdependencies between the two. There is a similar 172 problem with several other terms such as "vicarious interactors" (Sutton 2001) or "read-only 173 participants" (Nagel et al. 2009); all of which focus only on those individuals who do *not* 174

Intern. J. Comput.-Support. Collab. Learn.

contribute to a discussion. This has given the term lurker a negative connotation (because of 175the lack of contribution); however as described above, the act of attending to others' posts in 176an online discussion can very much be a part of productive discussion activity. Practically, 177users who have the highest activity in accessing others' posts are often also the most active 178contributors (Muller et al. 2010); thus, looking at these behaviors for only non-contributors 179leaves out an important part of the picture. Finally, in the context of formal learning discus-180sions where there is an expectation (and often a requirement) that learners contribute, the 181concept of lurkers excludes the majority of individuals involved. 182

The ways in which learners attend to others' posts in an online discussion has also been 183referred to as "reading" (Nagel et al. 2009; Hewitt 2003). While the physiological processes of 184reading text in an online discussion and that of a book are the same, the *cognitive* processes 185involved in the activities differ due to the nature of the text. Specifically, reading often involves 186a static text that was written by a single author (or collaborative team) as a cohesive whole; 187 examples include books, essays, newspaper articles etcetera. In contrast, online discussions are 188 multi-authored, dynamic and consist of discrete sub-units (posts), which must be made sense 189of together (Wise et al. 2012c). Due to these differences, participants in an online discussion 190need to engage with the text in particular ways to make sense of it. For example while we often 191read a book linearly from start to finish, knowing that we can take a rest and return to the same 192point we left off with nothing having changed, within a discussion there are multiple branches 193to choose from, comments can be added to previously read parts of the text, and there is a need 194for the reader to mentally integrate (and evaluate) the ideas contained in posts made by 195different authors. While these efforts are particularly pronounced when posts are disjointed, 196even in a coherent discussion interrogating the relationships between posts is an important part 197of the sense-making that helps one determine where to position oneself in the conversation. 198Thus, the generic term reading has some of the same problems as the term lurking in that it 199refers to the taking in of the externalization of another's work without connecting it to the 200eventual process of contributing to the discussion. In sum, attending to others' comments is an 201important part of productive online discussion activity with qualities not well captured by the 202terms "lurker" or "reading." 203

What we know about listening in online discussions

Over the past 4 years we have explored students' online listening behaviors in a series of 205studies looking at the different ways students access others' posts in online discussions and 206their motivations for doing so. This work has informed our understanding of students' online 207listening behaviors in several ways. At the most basic level, the research consistently shows 208that listening activities make up a substantial portion of learners' participation in online 209discussions (Wise et al. 2012a, 2013a). For example, looking across 95 students in a blended 210undergraduate business course, almost three-quarters of the time spent in the system (and an 211212even greater percentage of the actions taken) was devoted to accessing existing posts (Wise et al. 2013a). In addition, on average students viewed 65 % of their peer's posts at least once. 213However, these figures vary greatly among individual students. For example, in a series of case 214studies of undergraduates in a fully online education class, the proportion of total time spent on 215listening activities ranged from 47 to 97 % and the percentage of peer's posts viewed ranged 216from 38 to 100 % (Wise et al. 2012a). Notably, even in the cases at the lower boundary, 217listening actions still accounted for a substantial portion of activity in the discussions. Thus 218while it cannot be generally said that students do or do not attend to each other's posts, we can 219assert that online listening behaviors are an extensive part of discussion participation. Equally 220221important, students' listening behaviors are clearly diverse. We now move from the question of

224

if students attend to others' posts in online discussion, to examine the different ways in which 222 they do so. 223

Common listening patterns

In our research we have found several recurring patterns in how students attend to others' posts (Table 1). 226

The first pattern is characterized by minimal attention to the posts of others; we refer to this 227as disregardful listening. Students exhibiting this pattern demonstrate shallow behaviors in 228229attending to other's posts, viewing few posts overall and spending little time on those they do view (Wise et al. 2012b, 2013a). These students tend to spend minimal amounts of time in 230231discussions, often enacted through short and scattered visits (Wise et al. 2012a). Together, these behaviors denote a disregard for their fellow students' contributions. As an illustration, 232Student 37 in Wise et al. (2013a), logged-in to the discussion few times, spending most of this 233time reading the discussion prompt and composing his own response. In total he viewed only 23435 % of his peer's posts in the discussion, spending a very short time on each. 235

The second pattern is characterized by viewing many posts in a discussion but spending 236little time on each; we refer to this as *coverage* listening. Coverage listening differs primarily 237from disregardful listening in that it has a greater quantity of discussion posts viewed (Wise 238et al. 2012a). However, attention to these is superficial as students spend limited time reading 239each post, often only scanning quickly before moving on (Wise et al. 2012d). A coverage 240listening pattern demonstrates new post bias (Hewitt 2003, 2005) where listening activity is 241242directed primarily towards new posts in the discussion, and students commonly have short but frequent sessions of activity as they log in often to see if there are any new posts to view (Wise 243et al. 2012a, d). Some learners exhibiting a coverage pattern also spend time going back to 244 their own posts to review and/or edit what they previously wrote (Wise et al. 2012a, d). A 245coverage approach to listening in discussions may be content-driven or socially-motivated. 246When content-driven, students seem to treat the discussions as an additional text for the class; 247 viewing all posts but not referring to them directly in their own comments. For example, 248"Gigi" in Wise et al. (2012a) opened almost every post in her discussion, but only briefly. She 249often reviewed her own posts, toggling between them and other's posts in a seemingly 250comparative fashion, but took a formal academic tone in her posts, never mentioning anyone 251else's ideas. In contrast, when socially-motivated, a coverage listening pattern is associated 252with posts that repeatedly acknowledge others' comments with casual language ("nice com-253ment!"), but provide minimal engagement with their ideas (Wise et al. 2012a, d). 254

L pa	istening attern	Characteristic behaviors
D	Disregardful	Minimal attention to others' posts (few posts viewed; short time viewing). Brief and relativ infrequent sessions of activity in discussions.
С	Coverage	Views a large proportion of others' posts, but spends little time attending to them (often on scanning the contents). Short but frequent sessions of activity in discussions, focusing primarily on new posts.
F	ocused	Views a limited number of others' posts, but spends substantial time attending to them. Few extended sessions of activity in discussions.
Т	Thorough	Views a large proportion of other's posts and spends substantial time attending to many of th Long overall time spent listening; considerable revisitiation of posts already read.

Table 1 Listening patterns and their characteristic behaviors

+1 1

Intern. J. Comput.-Support. Collab. Learn.

In contrast to a coverage approach, the third listening pattern is characterized by extended 255attention to a select number of posts (Wise et al. 2012a, d). We refer to this as *focused* listening. 256Students exhibiting this pattern tend to have a limited number of sessions, but they are of 257greater length than those seen in disregardful or coverage patterns (Wise et al. 2013a). Students 258exhibiting focused listening also have a higher percent of sessions where they integrate their 259listening with their posting (Wise et al. 2012a). As an illustration, "Ron" in Wise et al. (2012a) 260participated in the discussion in just several long sessions. In these he viewed only 38 % of his 261classmates' posts, but he spent an extended amount of time on those he did read and often 262contributed a post after reading those of his peers. Focused listening may be directed toward 263particular content or individuals in the discussion, or reflect a general selectivity in what is 264read. For example, "Isabel" in Wise et al. (2012d) attended only to posts made by her 265instructor. 266

The final listening pattern is characterized by both attention to a high proportion of the posts 267in a discussion and also extended time spent on each post. We refer to this as thorough 268listening. Of the different patterns, thorough listening tends to spend the longest overall time in 269discussions (Wise et al. 2012a). Learners exhibiting this pattern often have a large number of 270sessions in which they come in to the system to view new posts but may also go back and 271revisit previous ones read (Wise et al. 2012a, d). As an illustration, "Tracey" in Wise et al. 272(2012d) spent the vast majority (87 %) of her time in the discussion reading others' posts. She 273viewed every post at least once and took her time reading most of these. She often revisited 274posts previous read and when she replied, it was always to a post that she had revisited at least 2753 times. 276

Taken together, these four listening patterns characterize the majority of listening activity277we have observed across various studies. While most learners exhibit a single listening pattern278throughout their discussion participation, at times learners may combine patterns. For example,279Student 82 in Wise et al. (2013a) followed a coverage pattern for most of their discussion280week, but exhibited a focused pattern in their final, extended session. Because learners' actions281do not always neatly align with a single listening pattern, it is also useful to be able to describe282specific characteristics of their listening behavior over time.283

Dimensions of online listening

As can be seen above, students attend to others' posts in online discussions in distinct and 285varied ways. However, some unifying dimensions across patterns can be identified (Wise et al. 2862013a). In particular, the four patterns described above can be uniquely distinguished by their 287breadth and depth of listening (Table 2). Listening breadth refers to the extensiveness of 288listening and can be considered both in terms of the total quantity of other's posts attended to 289(indicating the potential the diversity of ideas to which a learner is exposed) or their proportion 290out of the total number available (suggesting their ability to respond to the discussion as a 291whole). Listening depth refers to the degree to which learners consider others' ideas. It is 292difficult to assess precisely the amount of attention given to others' posts but listening depth 293

$t_{t2.2}^{t2.1}$	Table 2Alignment of four listen-ing patterns by breadth and depth	Depth	Breadth		
t2.3			Low	High	
t2.4		Low	Disregardful	Coverage	
t2.5		High	Focused	Thorough	

can be considered indirectly in terms of the amount of time spent on each post (a weak 294 indicator of the amount of cognitive processing involved) or the proportion of occasions in 295 which posts are attended to for long enough to allow for comprehension of the text (indicating 296 if others' ideas are being generally considered) [Hewitt et al. 2007]. Thus, the coverage 297 listening pattern described above is characterized by high breadth, but low depth of listening, 298 while the focused listening pattern exhibits high depth but low breadth. Disregardful listening 299 is low across both dimensions, while thorough listening is high across both. 300

In addition to breadth and depth, the four listening patterns can also be described in terms of 301 their temporal contiguity, (how a learner manages and divides their time within a discussion) 302 and listening revisitation (the extent to which a learner returns to posts made by themselves 303 and others that they have attended to previously. With respect to temporal contiguity, learners 304 in online discussions establish their own timelines of participation (Jonassen and Kwon 2001); 305 thus, they choose the number of times to log-in and if they spend these sessions primarily 306 attending to others' ideas or also contributing their own. For example, coverage and thorough 307 patterns are characterized by a higher number of sessions than focused and disregardful 308 patterns; and many of these are devoted solely to listening. Revisitation refers to the frequency 309 with which a learner re-attends to posts made by themselves and others. As mentioned 310previously, learners exhibiting a thorough listening pattern characteristically revisit posts made 311by their peers multiple times, while those exhibiting a coverage pattern often spend substantial 312time revisiting their own posts (Wise et al. 2012a, d). Both focused and disregardful patterns 313 \checkmark tend to have fewer revisitations of any kind. 314

Connecting listening to speaking

Above, we described common patterns of listening behavior and their key characteristics.316However, it is not yet clear if and how such behaviors contribute to "better" discussion317processes. To address this question, in this study we proposed and tested connections between318particular listening behaviors and the quality of comments made to a discussion.319

Conceptualizing speaking quality

The different characteristics, functions, and qualities of posts in online discussions have been 321theorized and studied by many researchers (for a selected overview see reviews by De Wever 322 et al. 2006 and Hew et al. 2010). Given the wealth of established work in this area, it is neither 323Q4 expedient nor useful to develop yet another idiosyncratic scheme for assessing post quality in 324online discussions. However, there is always a danger in adopting a pre-existing model that 325may carry strong epistemological or conceptual assumptions. Thus, our approach to concep-326 tualizing speaking quality was to look across the most commonly used models to identify the 327 core components considered important and create a scheme that could be easily used across a 328 variety of discussion contexts. Examined together, three common dimensions can be seen as 329330 important in a large number of models of discussion post quality: discursiveness (that learners' comments refer to each other in meaningful ways); content (that the learning material is 331thoughtfully considered); and reflectivity (that the learning process itself is taken as an object 332 for examination). 333

To begin, for discussions to function as interactive dialogues rather than a series of parallel 334 monologues (Boulos and Wheeler 2007), posts need to contain discursive elements through 335 which participants link their comments to each other. These elements can be responsive (e.g., 336 expressions of social support, proposing consensus) or elicitative (e.g., asking questions). 337

Intern. J. Comput.-Support. Collab. Learn.

Responsiveness itself can take many forms; at a basic level a simple act such as acknowledging 338 others may create the social support required for individuals to build trust, which is required in 339helping students take risks within a discussion (Cheung et al. 2008). At a deeper level, when 340 students respond to the ideas in a post they may expand or challenge that student's (and 341 others') existing thinking, and when they respond to multiple ideas synthetically they can 342 initiate a process of developing collective understanding (Gunawardena et al. 1997). Similarly 343 students may elicit responses from others by asking questions which can also contribute to the 344 interactivity of the dialogue as it promotes further responsiveness. 345

In addition to discursiveness, the extent to which posts engage with academic content is 346 central to learning through online discussions. A common way to assess this across multiple 347 discussion topics draws on the argumentation literature and looks at the degree to which 348 students make claims, and use reasoning, evidence, and theory to support them (e.g., Lin et al. 3492012; Weinberger and Fischer 2006). This is a more formal way of considering and connecting 350many elements of content quality long considered important such as engaging in critical 351analysis, expressing thoughts clearly, providing support for ideas, and drawing on sources 352(Rovei 2007; Pena-Shaff and Nicholls 2004; Hara et al. 2000; Wise et al. 2010). The underlying notion is that richer argumentation structures (more content-related claims and 354the greater use of supporting evidence, and theory) indicate deeper consideration of the 355learning material. Finally, the opportunity for reflectivity has been cited as a particular 356 advantage of asynchronous online discussion since time-unlimited review of earlier parts of 357 the discussion is possible (Harasim 2000; Knowlton 2005). Within a discussion, a student may 358consider the process of the group's knowledge construction (Knowlton 2005), but also the 359development of their own ideas on a topic (Pena-Shaff and Nicholls 2004). 360

Put together, these dimensions (discursiveness, content, and reflectivity) provide a useful361framework with which to examine the contributions a post makes to a discussion. In the next362section we describe theoretically predicted relationships between these aspects of speaking363quality and dimensions of online listening.364

How listening and speaking might relate

Theoretically, speaking and listening are intimately interrelated activities in the process of 366 constructing knowledge through online discussions; however, such connections have not yet 367 been examined empirically. Considering first breadth of listening, as students attend to a 368 greater proportion of their peer's posts they are exposed to a greater number and diversity of 369 ideas. Thus, we would expect them to be more discursive in their own comments, responding 370to and eliciting ideas from others. In addition as they become aware of a greater number of 371perspectives and views on the discussion topic, they are also likely to create posts with more 372 sophisticated argumentation that supports, and perhaps qualifies, their position with respect to 373 these other views. 374

Depth of listening is also expected to support both discursiveness and argumentation. First, 375 a richer understanding of peers' ideas should support more thoughtful responsiveness to 376 377 others' ideas as well as elicitation of further elaborations. Increased depth should also lead to stronger argumentation as students support or qualify their ideas based on this understand-378 ing. Although it is certainly possible to compose a post with strong argumentation without 379 reading others' posts, we argue that attending to others' posts provides a context and the need 380 to argue for one's own perspective as well as potentially acknowledge its limitations in the face 381382 of another viable position.

Turning to revisitation, re-attending to already viewed peer posts suggests additional 383 consideration of the ideas contributed by others, and thus would be expected to further support 384

353Q5/Q6

discursiveness and argumentation in the ways described above. Returning to ideas considered	385
(or contributed) previously also can support the process of reflecting on group and individual	386
learning processes by helping learners see how ideas have developed over time. Reflection	387
may also be supported by temporal dispersion; if students distribute their participation across	388
multiple days and sessions they may be able to notice changes in their own and others' views.	389
In contrast the temporal contiguity of conducting listening and speaking actions in the same	390
session may be needed as a foundation for relationships between the two activities to be	391
established.	392

Research questions

Our primary research questions probed the listening-speaking relationships described above: 394

- 1. What listening behaviors are associated with the discursiveness of a student's post in terms 395 of responsiveness and elicitation? 396
- 2. What listening behaviors are associated with the depth of content of a student's post in 397 terms of argumentation? 398
- What listening behaviors are associated with the reflectivity of a student's post in terms of individual and group reflection?
 399 400

In addition, we asked a follow-up question of a more exploratory nature:

4. How do listening-speaking associations manifest over time for learners exhibiting different listening patterns? 402

Methods

Learning environment and participants

Students in a fully online undergraduate course on educational psychology participated in 406 6 week-long small-group asynchronous discussions with 8–10 classmates. There were five 407 discussion groups in total. For each discussion, students were given two contrasting perspec-408 tives on an authentic educational controversy taken from their textbook. They were asked to 409debate the merits of the two positions and by the end of the week come to a collectively agreed 410 on position with rationale. Students were required to contribute at least two posts per topic on 411 different days and given guidance for making high quality posts (explore and explain ideas, 412 extend the existing conversation, give rationales and explanations, use supporting evidence 413from your textbook, compare the different arguments that have been made, identify areas of 414 consensus and dissonance). 415

Discussions took place within Phorum, a basic linear asynchronous discussion tool with threading. Discussions were conducted in three two-week sets (weeks 3/4, 8/9 and 11/12); the instructor gave students feedback on their individual participation and their group's final 418 consensus after the first two discussions (worth 5 % of the course grade) and the latter four 419 (worth 20 %). Prior to the formal discussions, students were given the opportunity to get to 420 know each other during an orientation week. Thirty-one of 52 students enrolled in the course 421 consented to have data on their discussion participation collected for the study.

393

404

405

Intern. J. Comput.-Support. Collab. Learn.

Listening variables

423

441

Clickstream (log-file) data was collected on all actions students took in the system to assess 424 listening activity; action types were "view" (opening others' posts), "post" (creating a post), 425"review" (revisiting previously viewed posts), and "edit" (making changes to one's previous 426posts). The log for each action contained the action type, a time-date stamp, ID of the student 427 taking the action, and length (number of words) of the post acted on. Extracted data was 428 filtered by user ID to separate participants, and times between subsequent actions were 429subtracted to calculate action duration. Views were subcategorized as scans or reads based 430the ratio of post length to time spent compared to a maximum reading speed of 6.5 words per 431second (wps) [Hewitt et al. 2007]. Because log-file data is recorded as a continuous stream 432 without a formal system log-out, sessions of activity needed to be determined manually. 433 Breaks between periods of activity can be detected by atypically long action durations (e.g. 434a "view" action calculated as lasting 16 h suggests abandonment of the system). A maximum 435allowed action length of 60 min was set (Wise et al. 2013a). Any action exceeding this 436 threshold was taken to be the end of a session of activity, and the action's duration was 437 recalculated as an estimate based on the student's average speed conducting the action and the 438length of the post acted on. Ten variables were calculated for the four different listening 439dimensions (Table 3). 440

Speaking variables

All 479 posts made by participants were extracted from the discussion tool and coded by two researchers for the five speaking variables described previously to evaluate post quality. The post was used as the unit of analysis for both theoretical and practical reasons as this was the unit through which students expressed their ideas in interaction with others and it presented an unambiguous basis for segmentation. Coding was based on a combination and adaptation of prior schemes and models by Hara et al. (2000), Knowlton (2005), Pena-Shaff and Nicholls

t3.1 Table 3 Summary of ten listening variables along four dimensions

t3.2	Dimension	Variable	Definition
t3.3	Breadth	% of others' posts viewed	# of unique posts made by others that a student viewed divided by the total # of posts made by others
t3.4		% of others' posts read	# of unique posts made by others that a student read divided by the total # of posts made by others
t3.5	Depth	% of real reads	<pre># of times a student read others' posts divided by their total # of views</pre>
t3.6		Av. length of real reads (min)	Total time a student spent reading posts, divided by the number of reads
t3.7	Temporal	# of sessions	# of times a student logged-in to the discussion
t3.8	contiguity	% of sessions with posts	# of sessions in which a student made a post, divided by their total # of sessions
t3.9		Participation range (days)	# of days between when a student first and last logged-in
t3.10	Revisitation	# of reviews of own posts	# of times a student reread posts they made
t3.11		# of reviews of instructors' posts	# of times a student reread posts made by the instructor
t3.12		# of reviews of other' posts	# of times a student reread posts made by others they had viewed previously

EDJII 14 Rati So 1 2 Roll (3 15/2014

450

Discursiveness	
Responsiveness (κ =0.71)	Elicitation (κ =0.91)
0 None	0 None
1 Acknowledging	1 Questions not clearly directed to anyo
2 Responding to an idea	2 Questions directed to one person
3 Responding to multiple ideas	3 Questions directed to the group
Argumentation (κ=0.74) 0 No argumentation 1 Unsupported argumentation (Position only) 2 Simple argumentation (Position + Reasoning 3 Complex argumentation (Position + Reasoning + 0)	Qualifier/preemptive rebuttal)
Reflectivity	
Reflection on Individual Process (κ =0.83)	Reflection on Group Process (κ =0.75)
0 No individual reflection	0 No group reflection
1 Shallow individual reflection	1 Shallow group reflection
2 Deep individual reflection	2 Deep group reflection

(2004), Weinberger and Fischer (2006), and Wise et al. (2012e); see Table 4 for an overview of the scheme used and Cohen's kappa for each scale. 449

Statistical analysis

Multi-level mixed-model linear regressions for each speaking variable on predicted relevant 451listening variables were conducted to examine relationships. Because students' discussion 452behaviors may change across a series of discussions, aggregating data across the entire 453semester could obscure relationships between listening and speaking behaviors. Thus, models 454 were based on variable averages calculated for each discussion week, the unit of activity in the 455course. For each model, the explanatory variables of interest were included as fixed effects 456(Table 5), as was Number of Posts per Group and Number of Posts per Student, while effects 457 of group-membership, discussion-week, group-by-week interactions, students-nested-within-458groups and student-by-week interactions were included as random effects. 459

t5.1 Table 5 Listening variables included in regression of speaking variables

t5.2	Speaking variables	Listening variables				
t5.3		Breadth	Depth	Temporal contiguity	Revisitation	
t5.4	Responsiveness, elicitation, argumentation	% of others' posts viewed	% of real reads	% of sessions with posts	# of reviews of othe students' posts	
t5.5		% of others' posts read	Av. length of real reads			
t5.6	Individual reflection, group reflection	_	_	# of sessions	# of reviews of:	
t5.7				Participation range	-own posts -instructors' posts	
t5.8					-other students' posts	

Intern. J. Comput.-Support. Collab. Learn.

We initially tested for random-effect student-by-predictor and group-by-predictor interac-460 tions, however the variation was non-significant, thus the interaction terms were discarded and 461 the model was fit assuming the same relationships of predictors to dependent variables for all 462students. While Type II errors are possible given the small sample size, in the face of a lack of 463 evidence that individual student or group slopes were significantly different, it was reasonable 464 to assume parallelity. In fitting the model, backwards elimination was used to iteratively 465remove explanatory variables' main effects and refit equations; a 0.10 significance level was 466 used for variable inclusion. The two post-count variables remained in the model regardless of 467 their significance. Subsequent inferences on the models were performed at the .05 level. After 468the fixed-effect models were specified, we tested for variability in the estimated variance 469components for the random effects group, week, and student using Wald tests. 470

Follow-up exploratory analysis

471

488

489

497

Learners were categorized by their dominant listening pattern across all six discussions using 472 the breadth-depth matrix (see Table 2 and further explanation below). We then calculated and 473 plotted weekly averages for learners in each category for all 15 listening and speaking 474 variables to compare differences across categories with theoretical expectations. Finally, we 475 plotted associated listening and speaking variables together for learners in each category to 476 examine how their listening-speaking relationships manifested over time. 477

To categorize learners, Percent of Others' Posts Viewed and Percent of Real Reads were 478used for discrimination along the breadth and depth dimensions respectively. Division was 479initially performed using a median split on each variable; cut-off points were 85 % of others' 480posts viewed and 45 % real reads. This produced a distribution of 9 minimal, 7 coverage, 7 481focused, and 8 thorough listeners. Because we could not presume equal distribution of learners 482 across patterns, we verified this categorization by looking for clear separations in the data. This 483identified slightly different cut-off points of 80 % and 50 %; however group membership was 484substantially similar and the interpretation of listening and speaking patterns was indistin-485 guishable. Because the median split categorization ensured an adequate number of learners in 486each group, we present those results below. 487

Results

Summary statistics

There was great diversity in listening and speaking behaviors in the discussions. All students490logged into the forum at least once over the course of the discussions; however, some engaged491in minimal participation with no posting and little attention to others' posts, while others492logged-in multiple times and read every post in the discussion (Table 6). The number of posts493in each discussion ranged from 13 to 52. The average level of Responsiveness was at the mid-494point of the scale, while Elicitation was low and Argumentation was high, though all varied495substantially. Reflection on both individual learning and group processes was consistently low.496

Multi-level regressions

Modeling results indicated that the Responsiveness of students' posts was related both to the 498 Number of Reviews of Others' Posts and the Total Number of Posts Made by the Group in a 499 particular discussion week (Table 7). Number of Reviews of Other Students' Posts was a 500

EDJHID 102 RitiS91 2 Roff (3 63/2014

A.F. Wise et al.

Variables	Mean	S. D.	Min	Max
Speaking quality				
Responsiveness	1.51	0.78	0.00	3.00
Elicitation	0.52	0.72	0.00	3.00
Argumentation	2.17	0.81	0.00	3.00
Reflection on individual learning	0.27	0.34	0.00	1.67
Reflection on group process	0.33	0.33	0.00	1.50
Speaking quantity				
Number of posts made (by group)	29.60	8.46	13	52
Number of posts made (by student)	2.57	1.60	0	10
Listening				
Breadth				
Percentage of others' posts viewed	0.72	0.31	0.00	1.00
Percentage of others' posts read	0.50	0.28	0.00	1.00
Depth				
Percentage of real reads (not scans)	0.44	0.21	0.00	1.00
Average length of real reads (in min)	3.85	3.21	0.00	17.35
Temporal Contiguity				
Number of sessions	6.96	5.23	0	29
Percentage of sessions with posts	0.40	0.26	0.00	1.00
Participation range (days)	4.08	1.87	0	7
Revisitation				
Number of reviews of own posts	2.56	3.21	0	18
Number of reviews of instructors' posts	10.30	11.23	0	93
Number of reviews of other students' posts	10.67	11.17	0	55

positive predictor (greater reviewing of others' posts in a discussion week by a student was 501associated with them making more responsive posts) while the Total Number of Posts Made 502by the Group was a negative predictor (a greater number of posts made by a group in a week 503was associated with lower average responsiveness in group members' posts). The level of 504Elicitation in students' posts was also predicted by the Number of Reviews of Other Students' 505Posts; however in this case the relationship was negative (more elicitative posts by a student in 506a discussion week was associated with less reviewing of others' posts). Richness of Argu-507mentation was predicted only by the Percentage of Real Reads (the percent of posts viewed 508that students actually read as opposed to scanned). This relationship was positive (a greater 509percentage of reading in a discussion week was associated with richer argumentation in the 510posts made). Neither Individual nor Group Reflection was significantly predicted by any of the 511listening variables; however Number of Reviews of Other' Posts met the $p \le .10$ threshold for 512inclusion in the Individual Reflection model. 513

Follow-up exploratory analysis

Before exploring how listening-speaking associations manifest over time for different students, 515 we first confirmed the presence of variability across learners. Among random effects in the 516

17 1

Intern. J. Comput.-Support. Collab. Learn.

		Estimate	Standard error	t value	p value
Responsiveness	# of posts per group	-0.018	0.009	-2.06	0.05
	# of posts per student	0.021	0.031	0.68	0.50
	# of reviews of other' posts	0.013	0.005	2.50	0.01
Elicitation	# of posts per group	-0.001	0.007	-0.19	0.85
	# of posts per student	0.047	0.035	1.34	0.18
	# of reviews of other' posts	-0.016	0.006	-2.65	0.01
Argumentation	# of posts per group	-0.003	0.009	-0.33	0.74
	# of posts per student	-0.041	0.024	-1.71	0.09
	% of real reads	0.522	0.257	2.03	0.05
Individual reflection	# of posts per group	-0.000	0.004	-0.10	0.92
	# of posts per student	-0.024	0.017	-1.40	0.17
	# of reviews of other' posts	0.005	0.003	1.66	0.10
Group reflection	# of posts per group	-0.003	0.005	-0.51	0.62
	# of posts per student	-0.017	0.015	-1.17	0.25

 Table 7
 Summary of fixed effects standardized regression coefficients for speaking variable models

model, there was consistent evidence that students exhibited substantial variability, although517that evidence rose to statistical significance for only three of the five variables (Table 8). No518other random effects showed significant variability.519

Characterizing students into the four groups (Thorough, Coverage, Focused, and Disregardful) according to their listening and speaking behaviors, Percent of Posts Viewed and 521 Percent of Real Reads clearly showed the theoretically postulated distinctions since these were the variables used for the categorization (see Table 2 and Methods section). Thus, Thorough 523 and Coverage students exhibited broader listening than Focused and Disregardful ones 524

t8.1 Table 8 Summary of variance component estimates for speaking variable models

		Estimate	Standard error	Z value	p value
Responsiveness	Group	0.000			>0.50
	Week	0.018	0.022	0.84	0.20
	Student	0.096	0.039	2.48	0.01
Elicitation	Group	0.042	0.060	0.70	0.24
	Week	0.000			>0.50
	Student	0.158	0.062	2.55	0.01
Argumentation	Group	0.021	0.028	0.72	0.24
	Week	0.017	0.017	1.00	0.16
	Student	0.023	0.018	1.29	0.10
Individual reflection	Group	0.007	0.014	0.53	0.30
	Week	0.000			>0.50
	Student	0.020	0.012	1.72	0.04
Group reflection	Group	0.019	0.018	1.08	0.14
	Week	0.007	0.006	1.05	0.15
	Student	0.008	0.006	1.36	0.09

EDJail 12 Rati S91 P. Roff OF5/2014



Fig. 1 Differences in a breadth and b depth listening behaviors used to characterize learners by listening pattern

(Fig. 1a), while Thorough and Focused students showed deeper listening than did the 525 Coverage and Disregardful ones (Fig. 1b). 526

Secondary variables for each dimension not used in the categorization confirmed the 527 expected patterns (Fig. 2a and b); particularly notable is that while Coverage listeners had as 528 high a Percentage of Posts *Viewed* as Thorough listeners (Fig. 1a), their Percentage of Posts 529 *Read* dropped dramatically to be equivalent of that of Focused listeners (Fig. 2a). This aligns 530 with the Coverage characterization as outlined earlier. 531

Temporal contiguity measures also followed theoretical predictions with Thorough listeners 532having the most Number of Sessions and greatest Participation Range of days in the discussion 533followed by Coverage then Focused then Disregardful listeners (figures not shown). While 534Coverage listeners exhibited the anticipated greater Number of Self Reviews compared to 535Focused or Minimalist listeners, the high Number of Self Reviews by Thorough listeners was 536unexpected (Fig. 3a). For Number of Peer Reviews, the ordering of different kinds of listeners 537was as anticipated for most weeks; but the high Number of Peer Reviews by Coverage 538listeners was unexpected since this pattern is theoretically characterized by many unique, 539shallow views (Fig. 3b). 540

Turning to speaking behaviors, the Number of Posts made by learners exhibiting each 541pattern followed theoretical expectations (Fig. 4a), however the expected differences in 542Argumentation as a measure of content quality between Thorough, Coverage and Focused 543listeners were not readily apparent (Fig. 4b). The pattern for Responsiveness was similar 544(figure not shown). For both of these variables Disregardful listeners' posts started off at the 545same level of quality as the other groups but deteriorated over time (Fig. 4b). No differences 546were seen for either of the reflection variables (figures not shown), possibly because values on 547these measures were uniformly low. 548



Fig. 2 Differences in \mathbf{a} breadth and \mathbf{b} depth listening behaviors not used in the initial listening pattern characterization

Intern. J. Comput.-Support. Collab. Learn.



Fig. 3 Differences in revisitation of a own and b peer posts for students categorized by listening pattern

We now examine differences in how listening-speaking relationships were manifest for students exhibiting each listening pattern; Responsiveness and Argumentation were examined as the respective primary indicators of discursiveness and content quality with significant predictors. As indicated by the overall predictive model, changes in the level of learners' Responsiveness corresponded with changes in the Number of Peer Reviews for all four groups (Fig. 5); this also occurred for Argumentation and Percent of Real Reads (Fig. 6). However the way in which these variables changed together differed across listeners. 559

For Disregardful listeners both speaking and listening variables show a downward trend 556over the 6 weeks of discussion (Figs. 5a and 6a). In contrast, Focused listeners showed high 557week-to-week variation in all variables but little change in their overall values (Figs. 5b and 5586b). Speaking and listening variables for Thorough and Coverage listeners were relatively 559consistent across time, with the exception of some tailing off in the Number of Peer Reviews 560by Coverage listeners towards the end of the term (Fig. 5c), and a substantial drop in the 561Number of Peer Reviews for Thorough listeners midway through (Fig. 5d). As noted above, 562while Thorough and Coverage listeners were differentiated by their listening depth (56 % 563versus 37 % Percent of Real Reads overall), their Argumentation levels were indistinguishable 564(Fig. 6c and d). 565

Discussion

The major finding of this study was a relationship between students' online listening (in terms of of depth and revisitation of others posts) and the quality of their speaking (in terms of discursiveness and content quality) in the online discussions. While a connection between 569 listening behaviors and speaking quality is implicit in much research on online discussions, 570



Fig. 4 Differences in speaking a quantity and b quality for students categorized by listening pattern

EDJhil 14 RitiS91 P. Roff 3 53/2014



Fig. 5 Weekly responsiveness and peer reviews for students categorized by listening pattern

this is the first work we are aware of that provides direct empirical evidence to support the 571 connection. Additionally, we report an initial indication that while the relationships held for all 572



Fig. 6 Weekly argumentation and percent of real reads for students categorized by listening pattern

Intern. J. Comput.-Support. Collab. Learn.

learners, they could be expressed in different ways over time. It remains to be seen if the 573 specific listening-speaking relationships found here exist in online discussions generally or if 574 there is variation across different kinds of learning contexts. Below we discuss the relation-575 ships found for this setting and how they manifested for different kinds of online listeners, 576 contextualizing our findings in the larger framework of prior research on online discussions. 577

Listening-speaking relationships

Discursiveness is an important element of posting in online discussions because it is what links 579individual comments together as a dialogue. Responsiveness can vary from simply social 580acknowledgements to building on, or challenging individual ideas, to synthetically integrating 581multiple perspectives (Gunawardena et al. 1997). The positive relationship found between 582revisiting others' posts and responsiveness suggests that in this setting the richer end of this 583spectrum tends to occur when learners attend to posts repeatedly. Examples of such behavior 584have been found in previous research. In one study (Wise et al. 2012a) we found that a student 585characterized as interactive in her discussion participation always spent substantial time re-586reading others' posts before making her own, highly responsive, posts. In another example 587(Wise et al. 2012d) a student who often built on others' posts and synthesized the group 588discussion always located her post as a reply to a post she had viewed at least three times 589already. Put together, this research suggests that in some discussion contexts reviewing 590previously read posts is an important element of effective participation. It is reasonable that 591students may need to read others' posts multiple times to make sense of them in the context of 592the discussion before being able to respond to the ideas with a complex and thoughtful 593response. However, prior research has documented students' tendency to do just the opposite; 594that is to focus on only new posts (Hewitt 2003). Recent work attempting to address this 595problem of new post bias through the design of a discussion forum interface that encourages 596students to read and re-read posts in a connected fashion (Marbouti 2012) may thus prove 597particularly valuable. 598

In contrast to the positive relationship found between revisitation and responsiveness, a 599negative association was found between revisitation and elicitation. This can be interpreted in 600 several different ways. It is possible that rereading previously viewed peer posts helped 601 students clarify some of the questions or doubts they had when they viewed those posts the 602 first time, leading them to ask fewer questions. However, elicitation was conceptualized to 603 include not only clarification questions but also raising wonderings to the group. Thus, another 604possible interpretation is that when learners repeatedly set questions to the group, they were 605more likely to focus their energies on the new responses to these, rather than posts they had 606 read previously. It is important to note that the overall levels of elicitation in the discussions 607 studied here were low; thus, this relationship may not generalize to other discussions in which 608 more vigorous questioning occurs. This is clearly an area that requires further investigation. 609

The final relationship found for discursiveness was that responsiveness was negatively 610 predicted by a greater number of posts in the overall discussion. This is consistent with 611 previous findings that a large amount of posts in a discussion lead students to feel 612 overwhelmed (Peters and Hewitt 2010) and suggests that it is beneficial to make groups small, 613 thus keeping discussions at a manageable size which allows students to be responsive as part of an interactive dialogue. 615

Considering content quality, previous work has questioned whether it is breadth of listening, depth of listening, or a combination of the two that is important to support the richness of post content (Wise et al. 2013a). The finding here of a relationship between the percent of real reads and richness of argumentation, clearly indicated depth as the more relevant dimension 619

655

for this learning context. This aligns with the finding of a relationship between rich respon-620 siveness and post revisitation since returning to a previously viewed post to consider it again 621 also conceptually indicates a depth of listening. Logically, it makes sense that deep attention to 622 peers' posts can support a richer understanding of meaning, and thus stronger argumentation, 623 as the understanding drives students to consider and support or qualify their own ideas more 624 deeply. This may help explain part of the mechanism by which conscientious design of online 625 discussion forums can encourage rich argumentation (Lin et al. 2012). In combination with the 626 lack of findings for listening breadth, it provides initial empirical evidence to support our 627 hypothesis that in at least some online discussion contexts, listening deeply to some of a 628 629 discussion is preferable to listening shallowly to all of it (Wise et al. 2013a).

Unfortunately, here again research shows us that students tend to do the opposite, focusing 630 on breadth rather than depth. For example, in one of the prior studies mentioned above we 631 found evidence of two students who viewed almost all the posts in their discussion, but did not 632 draw upon any others' ideas in their own posts (Wise et al. 2012a). Such findings, along with 633 work documenting students' use of widespread scanning as a strategy for coping with high-634 volume discussions (Wise et al. 2012c; Peters and Hewitt 2010), suggest that students do not 635 instinctively listen in the ways seen to positively relate to speaking in this study. There is thus 636 potential benefit in providing students with specific guidance on online listening and how it 637 can support them in making valuable discussion contributions. The strategy of guiding 638 listening behaviors explicitly as a way to enhance the quality of online discussions is addressed 639 further below. 640

Another factor exacerbating the problem of broad but shallow listening may be the use of 641 conspicuous indicators of unread posts (e.g., red flags) in discussion forum interfaces. In a 642 recent study scaffolding purposeful discussion participation, advanced graduate students and 643 their instructor both described actively having to resist the temptation to "click away the red" 644 even though they knew that it went against their discussion goals (Wise et al., in review). This 645 highlights a challenging design problem: how to balance the useful aspects of tracking which 646 posts have been read without calling undue attention to new unread ones (Marbouti 2012). 647

Finally, while not reaching significance there was evidence that revisiting others' posts may be associated with reflection on one's individual learning process. This makes sense theoretically since returning to ideas considered previously could help learners retrace the process of how their ideas developed over time. However, overall levels of reflection were low in this study, thus such a relationship requires further investigation. To do so it will be important to identify or stimulate discussions in which substantial reflection occurs. Without this, reflection may remain a much praised but little utilized affordance of online discussions.

Different expressions of listening-speaking relationships over time

Our follow-up analysis showed differences between students, but not groups, in how listening-656 speaking relationships were expressed over time. This reinforces our prior claim that certain 657 aspects of online discussion activity are best considered in terms of individual behavior rather 658than group dynamics (Wise et al. 2013a; see also Thomas 2002). Compared with other learners 659in this study, disregardful listeners showed the most distinct expression of listening-speaking 660 relationships over time. These listeners started off similar to others in their levels of discur-661 siveness and content quality, but then declined along these dimensions as well as the 662 corresponding listening dimensions of depth and revisitation. During this time, their behavior 663 on additional listening dimensions (e.g., breadth) did not show such dramatic decreases. This is 664 an unexpected finding suggesting that rather than simply being disregardful from the start, 665 666 these listeners became that way over time. This raises important questions about why this

Intern. J. Comput.-Support. Collab. Learn.

occurred and how it might be prevented. One possible explanation for their behavior is that as667learners' initial enthusiasm waned, they attempted to go through the motions of discussion668participation with less effort. Ironically, our finding suggests that if students in this learning669context have limited time to devote to online discussions, they would be better off focusing on670depth rather than breadth. Because prior work documenting disregardful listening has not671observed a decreasing pattern over time, the extent and generalizability of this phenomenon of672progressive disengagement needs to be investigated further.673

Other kinds of listeners were less clearly distinguished in their listening-speaking associ-674 ations. Focused listeners showed substantial week-to-week variation in both listening variables 675 and their corresponding speaking variables. This may be because their activity is more 676 concentrated, thus adding or omitting a single session of activity may have a large impact 677 on their variable values. Both coverage and thorough listeners showed relatively uniform 678 levels of speaking and listening variables, with the key difference being that coverage listeners 679 appeared to achieve similar levels of content quality with a lower overall depth of listening. 680 However, an important caveat in interpreting this finding is that coverage listeners' breadth of 681 listening may be masking some of their depth. In a previous cluster analysis of students' 682 listening behaviors (Wise et al. 2013a) we found that "broad" listeners actually spent a short 683 period of time surveying the whole discussion, while the majority of their listening efforts were 684 dedicated to deeply examining a small subset of the overall posts. If such initial inspection 685 informs the purposeful selection of posts to which to direct one's attention, then it may be a 686 productive prelude to focused listening. Alternatively, it may be an unnecessary expenditure of 687 effort that diverts students' time away from deeply engaging with posts. More work is needed 688 to unpack the different ways in which learners enact coverage listening patterns in particular 689 learning contexts and how these relate to speaking activity. 690

Importantly, while differences between focused, coverage and thorough listeners were not 691 always well-defined, the explanatory model of listening-speaking relationships held across 692them. Thus, regardless of what overall listening pattern a learner seemed to exhibit, a greater 693 depth of listening was associated with better content quality and more revisitation was 694 associated with richer responsiveness. This is encouraging since in practice it may be difficult 695 to change students' global approach to online discussions, but the concrete changes of 696 additional depth and revisitation within each pattern can be usefully promoted. In particular 697 an emphasis on depth over breadth (if appropriate for the learning context) may be helpful to 698 the many students who report experiencing online discussions as overwhelming (Peters and 699 Hewitt 2010). 700

Limitations and implications for future work

While click-stream data is useful in tracking how students attend to others' posts in online 702discussions, it also has some important limitations. We can detect if and when students open a 703post, but we cannot determine whether they are actually attending to it for the full time it is on 704their screen. Controlling for scanning activity and setting a maximum allowed action length in 705706 the calculation prevents extreme examples of off-task behavior from being counted, but will not catch shorter breaks in activity. The inverse problem occurs when learners engage in on-707 task activities outside of the discussion environment; for example, printing off posts to read in 708 hard copy or composing a post in an external tool. Both of these limitations add noise to the 709time-based data. For this reason we have found count data generally more helpful than 710 duration data in crafting useful listening measures. 711

Another important issue in creating listening measures is the unit of analysis. In the current 712 study we aggregated listening and speaking measures over each discussion week. While this 713

742

makes sense as a unit of activity in the course and is more precise than aggregating over the whole course, even more fine grained units of analysis (e.g., listening and speaking within a single log-in session) may provide additional insights. Similarly, the categorization of learners in the follow-up analysis was based on their dominant listening patterns across all discussions; however, characterizing each learner's listening pattern by discussion (or even session) might produce a somewhat different picture. 719

The research design used in this study enabled us to document naturally existing listening-720 speaking relationships; however, we cannot make claims about causality. While in some cases 721 there is a theoretical rationale for why we might expect listening behaviors to influence post 722 quality (e.g., increased listening depth ->richer content), in other cases the reverse is also 723 possible (e.g., greater elicitation ->less revisitation of previously read peer posts). It is also 724 possible that more conscientious students engage in greater listening and speaking behaviors, 725but there is no direct relationship between the two. Further research using an experimental, 726 interventionist design is needed to tease apart these possibilities. 727

Finally, this study examined the relationship between listening and speaking in one 728 particular learning context, that of a fully online undergraduate education course. Listening 729and speaking relationships may vary for different subjects, environments, course structures, or 730 learning tasks. In addition, research has shown important connections between the culture of 731 collaboration in a class and how students engage in online discussion activities (e.g., 732 Hakkarainen et al. 2002; Scardamalia and Bereiter 2006). It will thus be useful in future 733 research to examine relationships between listening and speaking in a variety of discussion 734 contexts. These should include both blended and online settings, as well as different subject 735areas, student levels, discussion group sizes, and kinds of discussion tasks. It will also be 736 important to study how online speaking and listening behaviors (and the relationships between 737 them) change when discussions are embedded in different learning cultures; for example 738 comparing classes where collaboration is engaged in regularly and intentionally versus those 739 where it is not, and situations where it is a voluntary, rather than compulsory, part of the 740learning experience. 741

Conclusion

This study is the first empirical work that we are aware of that examines the connection 743 between listening and speaking in online asynchronous discussions. This is an important area 744 for research since such interrelationship is presumed by most models of learning through 745online discussions, but had previously been untested. As shown in this study, patterns in 746 listening can help explain and predict patterns in speaking. Specifically, in this context when 747 students took the time to read and re-read some of their peers' posts, there were related benefits 748 in the quality of the posts they contributed. Importantly, these relationships held across the 749different kinds of overall listening patterns that learners exhibited. 750

The connection between these listening behaviors and post qualities is particularly impor-751752tant given the existing research base showing weak student listening behaviors and tendencies to focus on reading only new posts or using scanning-only as a strategy for coping with high-753volume discussions. Since the bulk of current guidance for students' participation in online 754discussions focuses on the qualities of a good post but not the process through which it is 755generated, understanding what listening behaviors are associated with what speaking qualities 756can provide new ways to support students in effective discussion participation. This may be 757 done in a variety of ways, including giving students explicit listening guidance, designing 758innovative discussion forum interfaces, and providing learning analytics to students on their 759

Intern. J. Comput.-Support. Collab. Learn.

listening behaviors. Current research in each of these areas is underway (Marbouti and Wise, 760 in review; Wise et al. 2013b). Importantly, constructive support for listening must connect it 761 to the larger activity of building ideas through responsive and reflective dialogue; otherwise 762students may rotely comply with the entreated listening behaviors without the intended 763 effects on speaking. The direct study of how learners attend to others' contributions is still 764 a relatively new area of research in computer-supported collaborative learning; in conjunction 765with current advances in data collection and analysis techniques we expect it to contribute 766 strongly to both our understanding of and ability to support student involvement in online 767 collaborative learning experiences. 768

Acknowledgments This work was supported by the Social Sciences and Humanities Council of Canada.

References

771 772

776 777

781 782

783

 $784 \\ 785$

786

787

788

789

 $790 \\ 791$

792

793

794 795

796

 $\begin{array}{c} 797 \\ 798 \end{array}$

 $\begin{array}{c} 799 \\ 800 \end{array}$

801

802

805

806

807 808

769

- Bodie, G., Worthington, D., Imhof, M., & Cooper, L. O. (2008). What would a unified field of listening look like? A proposal linking past perspectives and future endeavors. *International Journal of Listening*, 22(2), 103–122.
- 103–122.
 Boulos, M. N., & Wheeler, S. (2007). The emerging web 2.0 social software: an enabling suite of sociable technologies in health and health care education. *Health Information and Libraries Journal*, 24(1), 2–23.
- Brooks C, Greer J & Gutwin, C. (in press). The data-assisted approach to building intelligent technology enhanced learning environments. To appear in J. Larusson & B. White (Eds.) *The handbook of learning analytics: Methods, tools and approaches.* New York: Springer.
 778
 780
- Burleson, B. R. (2011). A constructivist approach to listening. *International Journal of Listening*, 25(1–2), 27–46.
- Cheung, W. S., Hew, K. F., & Ling Ng, C. S. (2008). Toward an understanding of why students contribute in asynchronous online discussions. *Journal of Educational Computing Research*, 38(1), 29–50.
- De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: a review. *Computers & Education*, 46(1), 6–28.
- Dennen, V. P. (2008). Pedagogical lurking: student engagement in non-posting discussion behavior. Computers in Human Behavior, 24(4), 1624–1633.
- Garrison, J. (1996). A Deweyan theory of democratic listening. *Educational Theory*, 46(4), 429–451.
- Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, 17(4), 397–431.
- Hakkarainen, K., Lipponen, L., & Järvelä, S. (2002). Epistemology of inquiry and computer-supported collaborative learning. In T. Koschmann, R. Hall, & N. Miyake (Eds.), CSCL 2: Carrying forward the conversation (pp. 129–156). Mahwah: Lawrence Erlbaum Associates.
- Hara, N., Bonk, C. J., & Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology course. *Instructional Science*, 28(2), 115–152.
- Harasim, L. (2000). Shift happens: online education as a new paradigm in learning. The Internet and Higher Education, 3(1/2), 41–61.
- Hew, K. F., Cheung, W. S., & Ng, C. S. L. (2008). Student contribution in asynchronous online discussion: a review of the research and empirical exploration. *Instructional Science*, 38(6), 571–606.
- Hewitt, J. (2003). How habitual online practices affect the development of asynchronous discussion threads. *Journal Educational Computing Research*, 28(1), 31–45.
- Hewitt, J. (2005). Toward an understanding of how threads die in asynchronous computer conferences. *The Journal of the Learning Sciences*, 14(4), 567–589.
- Hewitt, J., Brett, C., & Peters, V. (2007). Scan rate: a new metric for the analysis of reading behaviors in asynchronous computer conferencing environments. *American Journal of Distance Education*, 21(4), 215–231.
- Ho, C. H., & Swan, K. (2007). Evaluating online conversation in an asynchronous learning environment: an application of Grice's cooperative principle. *Internet and Higher Education*, 10(1), 3–14.
- Jonassen, D. H., & Kwon, H. (2001). Communication patterns in computer mediated versus face-to-face group problem solving. *Educational Technology Research and Development*, 49(1), 35–51. 810
- Knowlton, D. S. (2005). A taxonomy of learning through asynchronous discussion. Journal of Interactive 811 Learning Research, 16(2), 155–177. 812
- Lin, H., Hong, Z., & Lawrenz, F. (2012). Promoting and scaffolding argumentation through reflective asynchronous discussions. *Computers & Education*, 59(2), 378–384.

Q7

Lipponen, L. (2002). Exploring foundations for compute	er-supported collaborative learning. In G. Stahl (Ed.),	815
Proceedings of CSCL 2002 (pp. 72-81). Boulder: IS	LS.	816
Marbouti, F. (2012). Design, implementation and testing	of a visual discussion forum to address new post bias.	817
Unpublished masters thesis. Burnaby, CA: Simon Fr	aser University.	818
Marbouti, F. & Wise, A. F. (in review). Starburst: A new	graphical interface to support productive engagement	819
with others' posts in online discussions.		820
Muller, M., Shami, N. S., Millen, D. R., & Feinberg, J. (2	2010). We are all lurkers: consuming behaviors among	821
authors and readers in an enterprise file-sharing	service. In Proceedings of GROUP'10 ACM 2010	822
International Conference on Supporting Group Work	(pp. 201-210). Sanibel, FL: ACM	823
Nagel, L., Blignaut, A. S., & Cronjé, J. C. (2009). Read-	only participants: a case for student communication in	824
online classes. Interactive Learning Environments, 1	7(1), 37–51.	825
Nonnecke, B., Preece, J., Andrews, D., & Voutour, R. (2	004). Online lurkers tell why. In Bullen, C., Stohr, E.	826
(Eds.). Proceedings of the Tenth American Conference	ce on Information Systems 2004 (pp. 1–7) New York:	827
Association for Information Systems.		828
Pena-Shaff, J. B., & Nicholls, C. (2004). Analyzing stude	ent interactions and meaning construction in computer	829
bulletin board discussions. Computers & Education,	42(3), 243–265.	830
Peters, V., & Hewitt, J. (2010). An investigation of stud	ent practices in asynchronous computer conferencing	831
courses. Computers & Education, 54(4), 951–961.		832
Preece, J., Nonnecke, B., & Andrews, D. (2004). The	top five reasons for lurking: improving community	833
experiences for everyone. Computers in Human Beh	avior, 20(2), 201–223.	834
Rafaeli, S., Ravid, G., & Soroka, V. (2004). De-lurking in	virtual communities: A social communication network	835
approach to measuring the effects of social and culture	ral capital. In Proceedings of the 3/th Annual Hawau	830
International Conference on System Sciences, (p/020	13, 10pp). Big Island, Hawaii: IEEE.	831
Scardamalia, M., & Bereiter, C. (2006). Knowledge build	ling: Theory, pedagogy, and technology. In K. Sawyer	838
(Ed.), Cambridge handbook of the learning sciences	(pp. 97–116). New York: Cambridge University Press.	839
Stanl, G. (2005). Group cognition in computer-assisted	collaborative learning. Journal of Computer Assisted	840
Learning, $21(2)$, $79-90$. Starthan D. D. (1087), On listening. The Dii Date Kenne		041
Strotner, D. B. (1987). On listening. The Phi Delta Kapp	an, 08(8), 025-028.	842
Suthers, D. D., Dwyer, N., Medina, K., & Vatrapu, R. (2	010). A framework for conceptualizing, representing,	040 044
and analyzing distributed interaction. International 50 $5(1)$ 5 42	urnai of Computer-Supported Collaborative Learning,	845
J(1), $J=42$.	in computer mediated communications. International	846
Journal of Educational Telecommunications 7(2) 22	a ni computer-mediated communications. <i>International</i>	840
Thomas M. I. W. (2002) Learning within incoherent stru	J=242.	8/18
of Computer Assisted Learning 18(3) 351 366	ictures, the space of online discussion forums. <i>Journal</i>	840
Webb E Jones A Barker P & van Schaik P (20)	04) Using e-learning dialogues in higher education	850
Innovations in Education and Teaching International	41(1) 93–103	851
Weinberger A & Fischer F (2006) A framework to	o analyze argumentative knowledge construction in	852
computer-supported collaborative learning Computer	rs & Education $46(1)$ 71–95	853
Wise A F Zhao Y & Hausknecht S N (in review) Le	arning analytics for online discussions: Embedded and	854
extracted approaches	unning unaryties for online discussions. Enlocaded and	855
Wise, A. F., Hsiao, Y. T., Marbouti, F., Speer, J. & Perera	A. N. (2012a). Initial validation of "listening" behavior	856
typologies for online discussions using microanalytic	case studies. In J. van Aalst, J., K. Thompson, K., M.	857
Jacobson, & P. Reimann (Eds.) Proceedings of the 1	0th International Conference of the Learning Sciences	858
2012 (pp. 56–63). Sydney, Australia: ISLS.	, , , , , , , , , , , , , , , , , , ,	859
Wise, A. F., Hsiao, Y. T., Marbouti, F. & Zhao, Y. (2012)	o). Tracing ideas and participation in an asynchronous	860
online discussion across individual and group levels	over time. In J. van Aalst, K. Thompson, M. Jacobson	861
& P. Reimann (Eds.) Proceedings of the 10th Interna	tional Conference of the Learning Sciences 2012 (pp.	862
431–435). Sydney, Australia: ISLS.		863
Wise, A. F., Marbouti, F., Hsiao, Y., & Hausknecht, S.	(2012c). A survey of factors contributing to learners'	864
"listening" behaviors in asynchronous discussions.	Journal of Educational Computing Research, 47(4),	865
461–480.		866
Wise, A. F., Perera, N., Hsiao, Y., Speer, J., & Marbout	, F. (2012d). Microanalytic case studies of individual	867
participation patterns in an asynchronous online discu	ssion in an undergraduate blended course. Internet and	868
Higher Education, 15(2), 108–117.		869
Wise, A. F., Saghafian, M., & Padmanabhan, P. (2012e).	Fowards more precise design guidance: specifying and	870
testing the functions of assigned student roles in onli	ne discussions. Educational Technology Research and	871
Development, 60(1), 55-82.		872

Intern. J. Comput.-Support. Collab. Learn.

- Wise, A. F., Speer, J., Marbouti, F., & Hsiao, Y. (2013a). Broadening the notion of participation in online
 discussions: examining patterns in learners' online listening behaviors. *Instructional Science*, *41*(2), 323–
 874
 343.
- Wise, A. F., Zhao; Y. & Hausknecht, S. N. (2013a). Learning analytics for online discussions: A pedagogical model for intervention with embedded and extracted analytics. In D. Suthers & K. Verbert (Eds.)
 Proceedings of the 3rd Conference on Learning Analytics and Knowledge (pp. 48–56). Leuven, Belgium: ACM.
- Wise, A. F., Zhao, Y., Hausknecht, S. & Chiu, M. M. (2013b). Temporal considerations in analyzing and designing for online discussions in education: Examining duration, sequence, pace and salience. In E. Barbera & P. Reimann (Eds.) Assessment and evaluation of time factors in online teaching and learning (pp. 198–231). Hershey, Pennsylvania: Idea Group Incorporated.
 880

RECTE

COR