

Epistemic Networks for Epistemic Commitments

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Abstract: The ways in which people seek and process information are fundamentally epistemic in nature. Existing epistemic cognition research has tended towards characterizing this fundamental relationship as cognitive or belief-based in nature. This paper builds on recent calls for a shift towards activity-oriented perspectives on epistemic cognition and proposes a new theory of ‘epistemic commitments’. An additional contribution of this paper comes from an analytic approach to this recast construct of epistemic commitments through the use of Epistemic Network Analysis (ENA) to explore connections between particular modes of epistemic commitment. Illustrative examples are drawn from existing research data on children’s epistemic talk when engaged in collaborative information seeking tasks. A brief description of earlier analysis of this data is given alongside a newly conducted ENA to demonstrate the potential for such an approach.

Introduction

Seeking information in online environments is an increasingly important activity in a world in which students are no longer directed to pre-selected course books and materials. Yet, searching is a skill with which many – across age ranges – struggle. While support for technical aspects of searching may be of some assistance, we agree with Mason, Ariasi and Boldrin’s claim that complaints regarding students’ abilities at navigating the web are not technological, but rather epistemic issues around “the nature of knowledge and knowing, which may facilitate or constrain searching and evaluating sources of information on the internet” (Mason, Ariasi, & Boldrin, 2011, p. 139). This paper takes as its focus the seeking of information, claiming that this activity – particularly as mediated by and conducted through search engines – provides an *epistemic lens* through which researchers may explore the commitments learners make explicitly and implicitly about knowledge. These commitments are implicated in the ways students *select* sources, *use* them, and *make connections* between them in any information-seeking task. Analysis to explore issues at this level, and understand how to support learners to engage more effectively in their search practices is important. Both professional and academic learning contexts require high levels of information literacy; as such, an activity-oriented perspective on developing skills to support such literacy is an important contribution. This paper builds on recent contributions (including at ICLS 2012) calling for a shift from psychometric assessments for epistemic cognition, towards an exploration of the situated contexts in which epistemic practices are brought to bear. Specifically, we argue for a new approach: epistemic *commitments* – action-oriented ways of working – rather than *beliefs*, and the analysis of such commitments using Epistemic Network Analysis (ENA) to explore the connections between epistemic modes of information seeking. We suggest a focus on trace indicators of behaviors, and the connections between particular types of behavior (as analyzed using ENA) offer a productive new approach to the investigation of epistemic practices.

Seeking Information as an Epistemic Lens

In describing the established epistemic cognition literature, Mason (2009, p. 69) highlights broad agreement across models on the importance of two main facets – *what knowledge is*, and *how one comes to know*. Within the first area, two dimensions are noted: the *certainty* of knowledge (how stable or tentative knowledge is); and the *simplicity* of knowledge (how holistic a perspective of interrelated concepts, or simplistic a perspective of compartmentalized facts is taken). Similarly, Mason identifies two dimensions of the second area: the *source* of knowledge (from transmission to constructivism); and the *justification* for knowing (what warrants a knowledge claim – from authority to rules of inquiry). These models have informed analysis of the comprehension of multiple online sources – which may vary radically in the nature of their sourcing and justifications – in the understanding that students who regard knowledge as simple and finite may conduct brief and perfunctory searches with little recourse to integration or multiple sourcing (Barzilai & Zohar, 2009; Bråten & Strømsø, 2006). We thus agree that, “exploring students’ thought processes during online searching allows examination of personal epistemology not as a decontextualized set of beliefs, but as an activated, situated aspect of cognition that influences the knowledge construction process” (Hofer, 2004, p. 43).

Research in this area indicates that students with more sophisticated inquiry stances are more likely to evaluate websites, and to do so meaningfully, while those with more sophisticated perspectives on the multiplicity of knowledge (or multiple perspectives) are more likely to integrate and critically evaluate multiple

online sources (Barzilai & Zohar, 2009; Bråten & Strømsø, 2006). While epistemic cognition is not a significant factor in understanding *converging* perspectives in online sources, for *conflicting* sources, those with evaluativist beliefs (who critique claims) perform significantly better in their comprehension (Barzilai & Eshet-Alkalai, 2013). A growing body of work associates search and sourcing patterns with particular patterns of epistemic metacognition (Mason et al., 2009), with think-aloud research indicating that students engaged in web-based learning spontaneously engage in epistemic reflection, particularly around source selection and credibility (Mason et al., 2011; Mason, Boldrin, & Ariasi, 2010), where students who verbalised about source credibility and information veracity significantly outperformed those who evaluated only sources (Mason et al., 2011). It should be noted, however, that the use of think-aloud protocols may increase such practices (Schraw & Impara, 2000; Schraw, 2000). We return later to the possibility that the *collaborative* search context may have higher external validity, as well as offering methodological advantages for gaining insight into a group's epistemic practices.

Situating Epistemic Commitments

The context of search is thus an interesting one for our investigations. Recent work has rejected an analysis of *beliefs* in favor of an action-oriented view:

What we have called tacit epistemic beliefs might better be called epistemic commitments (Chinn & Brewer, 1993). Some theorists may be uncomfortable with the idea that one can have a tacit 'belief' that cannot be expressed, and the term epistemic commitment avoids reference to such beliefs. An epistemic commitment reflects a tendency to act in specified ways, such as a proclivity to provide justifications based on personal experience (Chinn, Buckland, & Samarapungavan, 2011, p. 146).

Furthermore, Sandoval (2012) has made related claims, calling for epistemic cognition researchers to take seriously a 'situated' approach:

One important way to understand the epistemic ideas that people bring to bear is to examine their participation in practices of knowledge evaluation and construction. Changes in the form of participation are indicators of changes in the meaning that individuals make of the activity in which they are engaged. [...] Change in participation can indicate a shift in epistemic perspective, but it is the shift itself that suggests what particular epistemic ideas are brought to bear in the first place (Sandoval, 2012, p. 350)

In a similar vein, Tsai (2004) suggests that information commitments involve "specific views about what counts as a successful explanation in the field (e.g. science) and [...] general views about the character of valid knowledge or information" (Tsai, 2004, p. 105). Tsai (2004, p. 109) thus proposes three dimensions:

- *Standards for correctness*: evaluative standards ranging from 'authority' to 'multiple sources'
- *Standards for usefulness*: assessment of the usefulness of web-materials, ranging from 'functional' (e.g. ease of retrieval), to 'content' (e.g. relevance of retrieved information)
- *Searching strategy*: information-search strategy ranging from 'match' (of simple claims to questions) to 'elaboration and exploration'

While this turn from epistemic beliefs to commitments is an interesting one for analytics/data mining researchers who wish to analyze learners' behavioral traces as proxies for epistemic beliefs, it is still problematic, not least because as Wu and Tsai (2005) highlight, students may utilize both of the information commitments ('multiple sources' and 'authority') at the same time when evaluating the accuracy of the materials on the Web – a scenario which this framework does not have conceptual resource to explain. That is, while the orientations are proposed as dichotomous, or scalar, it is not clear that it is appropriate to think of them in such a way.

In our view, the action-oriented shifts described above are best characterized by the connections learners make between aspects of their sourcing behavior and information use. Thus, the focus should be on the emergence of information needs, and the use of multiple implicit and explicit criteria to assess the suitability of information for meeting those needs is dictated by a complex combination of searcher's action, task context, and technical mediation. Importantly, "...information seeking is not carried out for its own sake but to achieve an objective that lies beyond the practice of information seeking itself." (Sundin & Johannisson, 2005, p. 107). Therefore credibility assessments do not stand alone, but are connected to the continued seeking of information, and the ways in which information is used. Thus individual activities should not be considered in isolation: selecting multiple sources; claims around source authority; connecting pieces of information in complex ways; and so on, are not in themselves complex or simple. Context sensitivity is fundamental for a sophisticated epistemology; it is not very sophisticated to view the idea that the earth is round rather than flat as 'tentative' whereas theories of dinosaur extinction do require a more tentative stance (Barzilai & Zohar, 2012, p. 42).

Epistemic Frames

Epistemic Frame Theory (EFT) provides a means to conceptualize these connections between commitments. Epistemic Frames can be thought of in terms of the connections between elements usually described as: skills, knowledge, values, identities, and epistemological rules, from any particular domain. EFT is explicitly discourse oriented, and argues that an approach called Epistemic Network Analysis (ENA) may give insight into the frames of experts and novices working in a domain (Shaffer & Graesser, 2010; Shaffer et al., 2009). ENA thus offers a way to model the relations among elements of epistemic frames – which are constituted in discourse: particular facets of the frame (e.g. keywords indicating particular ways of working) become nodes, while connections between those nodes represent the patterns of connections between frame facets (e.g. the co-occurrence of keywords).

The search context is a particularly interesting one in which to deploy ENA. The theory takes as its unit of analysis any chunk of dialogue (a session) broken into meaningful chunks (stanzas). In the case provided in this paper we chunk stanzas by task, but for other analyses it may be more appropriate to chunk by search query. ENA allows us to model various types of connections, and broadly examine whether or not particular ways of making sense of information – in the confines of answering questions, or attempts at deeper understanding – co-occur with particular types of sourcing or connections between knowledge. Moreover, such analysis may offer insight into the quality of frame elements (nodes) – for example, claims about the ‘authority’ of websites might be rather trivial (for example, “it looks good”) or more sophisticated (for example, “they used a scientific method”). Understanding how such justificatory elements of the frame are connected to sourcing elements may give insight into the pedigree of those sourcing decisions which would be missed by looking only for ‘authority’ claims. When we seek information we search for both in the sense that we search for information, and we search for a purpose; how users engage with those purposes is what matters, and how they connect those purposes to their epistemic commitments. Their sourcing decisions and the way they conceptualize the complexity of information is crucial. Thus, while search strategies matter, and an overreliance on individual (authoritative) websites or the consistent use of multiple websites (corroboration) might be of concern, their relationships to other epistemic assumptions are key.

In the work reported in this paper we take a previously analyzed dataset, and apply ENA to the epistemic discourse around searching for information to address a number of pre-assigned questions. We discuss the dataset further below, note though, that the use of this pre-existing dataset allows us to compare insights gained through close textual analysis, and those offered through ENA, thus supporting the development of a ‘proof of concept’ model for ENA around epistemic commitments.

The Collaborative Lens

A fundamental component of understanding the social context and role of language in learning is an analysis of how language mediates and represents learners’ views on their learning. This component of learning is also fundamental to the theoretical and practical application of ENA, which takes as its data the discourse used in the course of students’ learning practices. As noted above, it also avoids the methodological risk of artificially activating metacognitive strategies through the use of think-aloud techniques.

High quality collaboration also entails particular – epistemic – ways of working. In the context of epistemic commitments, take for example Hutchinson and Hammer’s (2010) case study from a science classroom, in which framing by students which could be characterized as ‘sensemaking’ in nature (and, as we note below, accountable or exploratory) is contrasted with a more absolutist perspective. For example, at one point a student (Bekah) offers and explains an equation to illustrate her understanding – this is taken up and referred to collectively as “Bekah’s Law”, illustrating a cohesive tie (the repetition of terms through a text) demonstrating a type of common knowledge built up in that classroom (Hutchison & Hammer, 2010). This type of talk bears striking resemblance to exploratory or accountable talk, research on which focuses on the ways in which language is used “as a social mode of thinking – a tool for teaching-and-learning, constructing knowledge, creating joint understanding and tackling problems collaboratively” (Mercer, 2004, p. 137). In exploratory dialogue:

Partners engage critically but constructively with each other’s ideas. Statements and suggestions are offered for joint consideration. These may be challenged and counter-challenged, but challenges are justified and alternative hypotheses are offered. Partners all actively participate, and opinions are sought and considered before decisions are jointly made. Compared with the other two types, in exploratory talk knowledge is made more publicly accountable and reasoning is more visible in the talk. (Mercer & Littleton, 2007, p. 59)

In such talk, explanatory terms and phrases are more common, for example: *I think; because/cos; if; for example; and also*. Similar characterizations of effective dialogue have emerged from the work of other researchers across a range of ages (Michaels, O’Connor, Hall, & Resnick, 2002; Resnick, 2001). This talk is thus explicitly epistemic, in that it embodies consideration of “the other’s” perspective. The significance of this

type of dialogue for the study of epistemic commitments receives further support from Reznitskaya and Gregory (2013) who note that more sophisticated epistemic cognition of the ‘evaluativist’ variety, is closely associated with the kind of exploratory talk which is associated with educational gains. This claim – of an epistemic relationship to exploratory talk – is further supported in Rosenberg, Hammer and Phelan’s work (2006). In that study, a case study was presented of a 15 minute discussion of the ‘rock cycle’ by a group of 8th graders – again, making use of dialogue excerpts to exemplify. Rosenberg et al., note that in the initial stages students were engaged in largely unproductive talk (there was some accretion of knowledge, with little explanation or evidence of understanding – it was largely *cumulative* in nature), suggesting this was because: “They [were] treating knowledge as comprised of isolated, simple pieces of information expressed with specific vocabulary and provided by authority” (Rosenberg et al., 2006, p. 270). After a brief intervention by the teacher, suggesting the students might build on their own knowledge, this talk instead shifts to more productive dialogue, seeking coherence and understanding in trying to create a theory and use terms they understand – the description, and excerpts provided here suggest this talk might be characterized as more ‘exploratory’ in nature. Exploratory dialogue is thus closely associated with a component of our approach to epistemic commitments around openness to ideas, and justification for them. This is particularly interesting given evidence that collaborative information seeking is a common activity (see Shah, 2012 for a review), and may have benefits for information seeking in classroom contexts (Lazonder, 2005).

A Proposal for Epistemic Commitments

In addition to exploratory dialogue, other components of epistemic cognition are highlighted in the literature. Earlier we noted Mason et al.’s (2009, p. 69) claim that across models of epistemic cognition, there was a focus on the certainty, simplicity, source and justification for knowledge. We then noted Tsai’s (2004, p. 109) framework for information commitments, comprised of: standards for correctness; standards for usefulness; and searching strategy. We thus recast these two positions such that our focus is on:

1. *Which sources of information are selected* – comprised of credibility decisions (from corroboration of information across sources, to trust in the authoritativeness of sources)
2. *How information is used* (in action – to justify claims, to make decisions) – comprised of justifications and source use (from dialogic approaches using talk of an exploratory nature, to attempts to directly approach questions by matching information to answers)
3. *How links between information are created (or not)* – comprised of claims, (explicitly in language and through structured environments, as well as implicitly through search patterns) made around connectedness of concepts (from a holistic to a piecemeal perspective of knowledge)

This recasting aligns well with the specific context being studied here – that of collaborative information seeking. It also provides three conceptually distinct (although probably empirically associated) constructs for study. In the two other models highlighted – Tsai’s information commitments, and the general model described in Mason’s analysis of the literature – it is not clear that each component can be conceptually distinguished. Specifically, ‘certainty’ in the general model seems likely to be a function of justification and simplicity. The sophistication of one’s perspectives on ‘certainty’ depends on the purpose for which the information is being deployed, and the other information to which it is being associated – and indeed, whether one holds a complex enough view of knowledge to recognize the instability of certain information. Indeed, ‘certainty’ could be characterized as a connection between a facet of the information (publication date metadata, for example) and justification (recency, or information being well ‘established’ for example). Similarly, it is not clear that ‘searching strategy’ is a useful conceptualization of an information commitment given its strong relation to the tools at hand, and the type of task set and justificatory framework required for that task. The proposed model focuses on *whom we believe, how we justify claims; and how holistic a conception we have*. However, although ‘epistemic commitments’ recasts the constructs of other models, it still provides a lens for them. For example, ‘certainty’ is recast in light of our standards for credibility, explanation, and relating components of information such as new and old, or geographically located information; ‘simplicity’ is most clearly related to the third focus on connectivity; source to the first; and ‘justification’ to the second. Furthermore, the rhetorical shift both in the foci, and in the notion of ‘commitments’ over ‘cognition’ motivates an operationalization centered on:

1. *Source selection*, the corroboration of information across opened links, and the types of links repeatedly visited (e.g. use of authoritative sites such as ‘BBC’, repeated use of top links in search engine results pages, use of source metadata in the justificatory framework below).
2. *The type of justificatory framework used*, the assertion of information (perhaps closely related to a style of search which emphasizes precision of information with little consideration to its wider impact) versus reasoning and understanding activities (closely related to exploratory dialogue)

3. *The sorts of connections made* by students between concepts in their dialogue and document creation, and in the ways that users build links between information in their search patterns (building on search terms by rephrasing and appending new query terms, following internal links, and using terms from opened sources to find new ones all imply some commitment to holistic perspectives on knowledge).

This model thus describes both a conceptual and practical means to explore epistemic commitments in information seeking environments, and will be the model adopted in this work.

A Pilot Validation for Epistemic Commitments

The data described in this paper were taken from research the first author conducted in an English Secondary school with a pair and two trios of female 11 year old pupils (Knight & Mercer, Forthcoming). The researcher recorded an hour of discourse and (shared) display/browser use of the pupils while they were engaged in a set of assigned information seeking tasks around the topic of “role models”. Some questions were closed (“How many women have won the Nobel Prize?”) while others were more open ended (“Why do some people think Nelson Mandela is a good role model?”). In addition they were asked to justify their choices of information, and state their sources; these were questions explicitly designed to probe epistemic thinking. The data were analyzed for evidence of exploratory dialogue, and – making use of both the screencast and audio recordings – for epistemic behavior in pupil interactions with each other, and the information they sought. One of the groups was particularly unsuccessful in their performance (completing relatively few questions) while the other two performed rather better, although demonstrated some different ways of working. The original data were not ‘coded’ as such, rather a closer analysis using the methods of sociocultural discourse analysis (Mercer, 2004) was conducted. In the analysis here, this close focus on the properties of the text is used to motivate a shift towards coding utterances (turns by a single speaker) within stanzas (topically related sets of utterances; in this case utterances responding to set task questions) at the level of particular epistemic commitments by using key-terms (see **Error! Reference source not found.**).

Prior Analysis of the Data

As noted above, the data come from previous analysis with respect to epistemic cognition research, using a broadly sociocultural approach for a close hand-analysis of the transcript to explore the ways in which speakers make meaning together in context. In this section, we briefly summarize the findings of that research (which the first author conducted) before describing outcomes of ENA. There were marked differences in the behavior of the three groups. Group 1 in particular focused on how detailed sources were, and the repetition of keywords or information as indicators of usefulness, and had a general reliance on one website for many of the questions – although they talked very little about source quality, they spent some time discussing why their sources and information answered the questions and were ‘useful’. In contrast, group 2 explicitly sought particular types of authority, noting the quality of BBC material, and potential problems with some sites (such as answers.com). Group 2 were very focused on extracting direct answers to questions from websites, and emphasized the novelty of information (i.e. “I didn’t know that”) as reasons for its importance often without directly addressing the part of the question asking them to justify their selection of information, or attempting to corroborate or make connections between bits of information. Group 3 showed the starkest difference in their behavior – and indeed, the poorest performance in terms of task completion. They emphasized *quantity* of information over *quality*, making no distinction between the qualities of different sources even where corroboration was attempted (e.g. treating ‘answers.com’ sites as equal authorities to the official website for the Nobel Prize). Preliminary analysis of this data by the first author in light of the theory of commitments proposed, highlighted salience of keywords for dimensions as in Table 1 which were used to code utterances for the application of ENA.

Table 1 – Dimensions of Epistemic Commitments for ENA

Code	Definition	Example
Source – Authority	Make reference to authorities when selecting information	"use BBC, that's a good site", "just use the top site", "it's a reliable site"
Source – Corroboration	Make reference to repetition of information when selecting information	"we said x cuz it was on lots of sites", "well everyone agreed"
Justification – Matching	Little attempt to sensemake in question; targeted matching of source information to questions.	"it's an answer", "look, it says it there", "what's it asking?"
Justification – Understanding	Attempt to make sense of information, use more accountable/exploratory dialogue key phrases (or epistemic superordinate codes)	"because", "so", "I think"
Simplicity – Simple	Make few connections between information, look for individual tokens of knowledge	"all the information", "need more facts", listing of claims without connections

Code	Definition	Example
Simplicity – Complex	Make connections between tokens of information, possibly across questions, contextualize information (e.g. account for temporal aspect), and make judgments regarding relative utility of information	“important information”, making connections between claims (co-occurrence)
Search	Referring to search or webpage specific aspects of the task	“google that”, “click there”, “try searching for...”
General	References to general knowledge required (around role models in this case)	Keywords selected for general task relevance; e.g. “role models”
Specific	References to specific pieces of information in each question	Keywords selected for relevance to the specific questions asked e.g. “43 women”

Epistemic Network Analysis

Codes across epistemic commitments and search activities were applied at an utterance level (as examples in Table 1) with utterances grouped by question to form ‘stanzas’. Co-occurrence of codes in stanzas are then identified to create an adjacency matrix – a quantification of connections between nodes. In the search study all three groups discussed at least the first four (of nine) questions (although one group did not complete it) thus only these four stanzas are analyzed. In ENA, connections are weighted by their presence across stanzas. As such, it is possible to place a threshold on connections such that only the most prominent connections are selected (and graphed when using ENA visualizations). In this case, the threshold is set to the highest level at which all three groups show any connections between nodes, a level largely dictated by group 3 whose utterances were characterized by simple phrases (many of which were off-task) and thus had very few connections between nodes. Furthermore, nodes which represent the greatest variation across groups are visualized on opposing axes. Thus by looking at connections and distance on axes, differences between groups can be explored.

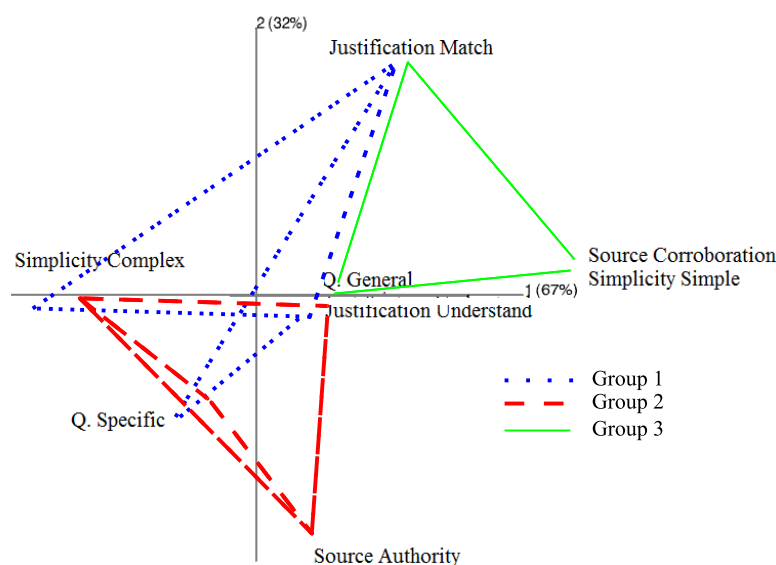


Figure 1. Epistemic Network Analysis for three groups' Epistemic Commitments

Figure 1 shows the ENA visualizations generated for Groups 1-3 (nodes have been combined to aid interpretation). Two dimensions accounted for most of the between-group variance. The x axis (dimension 1) accounts for most (67%) of the variance, with groups with low values making stronger connections with *Simplicity Complex*, and groups with high x values making stronger connections with *Simplicity Simple* and *Source Corroboration*. The y axis (dimension 2), then, largely distinguishes between *Justification Match*, and *Source Authority* with the use of question specific terminology. Here we see group 1 with larger y values representing stronger connections to matching, connecting to: understanding, making of *Question General* and *Specific* claims, and *Simplicity Complex*. Group one's talk might include things like: “we have to say *why* it matters, so [fact] is important because...”. In contrast, we see group 2 with lower y values representing greater use of *Authority* – making the same connections otherwise (the cluster in the middle). This group's talk might be characterized by phrases such as: “the answer's [fact], because it's a good site”.

The x axis defined the main difference between groups 1 and 2, and group 3 who made far fewer connections in general, and those that they did make were between: both *Corroboration* and *Simplicity Simple*, and making general claims, *Justification Understanding* and *Justification Match*. This might be interpreted as

indicating a perspective that simple knowledge obtained through corroboration is used to match general aims (and justified as such) although not actually targeting question specific knowledge claims (as is evident in the transcript and success rate with few targeted pieces of information associated with questions). Group 1 appears to be more focused on answering the questions using the information at hand, and making relationships between both the information found, and the questions. In contrast, group 2 appears to be focused on taking information from sources of authority that appear relevant to them. They still spend some time trying to relate this information and understand it, but they are not as focused on the requirements of the questions. It is interesting to note that there was little discussion of ‘search’ in any group, and that this is reflected in the lack of connections to this element of the frame. ENA thus offers a useful comparator for closer manual analysis. Through the analysis of connections in epistemic commitments, it gives many of the same insights as that closer analysis, while offering a method to scale analysis and provide real-time feedback.

Discussion

This paper set out to motivate a conception of epistemic commitments in the context of collaborative information seeking on the web, and to discuss the methodological and conceptual adequacy of ENA for their analysis. The example offered in this paper provides exemplifications of how such analysis might be conducted. Of course, ENA does not offer all the same insights as close manual analysis – for example, additional trace data would be required to identify specific websites used as authorities across contexts (e.g. ‘BBC’ here); further work will be needed to identify reliable key-terms. Some insights into other factors (such as novelty: “I didn’t know that”) are also lost, and some of these around unconnected commitments (as in the case of group 3’s emphasis of quantity) should usefully be displayed in visualizations to indicate their presence as unconnected nodes. However, the brief descriptions offered from prior analysis of the data may be favorably compared with ENA results. Given the recoding for such purposes, this is arguably unsurprising. However, we would argue that we have avoided the risk of circularity; while more work is needed, this paper provides preliminary validation that ENA offers a *representational tool* for scalable interpretation of epistemic commitments, and that the notion of connections in epistemic frames is a productive characterization of epistemic commitments, offering more insight towards close qualitative [sociocultural] discourse analysis than simpler coding methods. However, we do not wish to overstate the suitability of this analysis in this case – much more work will be needed to define the interpretative space through which ENA for epistemic commitments is explored, including use of data designed for such use, validation and reliability assessment for interpretations of ENA output, and more work on providing text-oriented processing capabilities rather than the pre-selected cases provided here. However, given continued calls for the development of more situated, activity-oriented theories of epistemic cognition, and the specific aims of ENA for capturing the development of professional practices through enacting those practices, it may be well suited for analysis of epistemic activities such as information seeking. Comparison with ‘expert’ groups will also provide important comparison data; ostensibly while ‘matching’ is certainly an important connection insofar as it is core to actually addressing questions, it should not be a feature which defines the best quality of group activity (and indeed, groups 1 and 2 were very similar in many ways). Nonetheless, the conceptual scheme and preliminary analysis reported in this paper provide a development in thinking about analysis of epistemic commitments as *practice oriented* elements of working in the world. The next steps in this investigation which we are now planning are designed to assess a number of hypotheses, including:

- 1) In sourcing decisions, ‘understanding’ will give insight into the appropriateness of those decisions (corroboration v authority) that would not be gained through a simple analysis of either mode alone
- 2) Connections between task specific knowledge claims, sourcing decisions, and information seeking (search) will support analysis better than any of these alone, with respect to specific information claims
- 3) Connections between sourcing decisions and general knowledge claims (around broad task requirements) will give more insight than either alone
- 4) Connections between modes of the same dimension (for example, corroboration and authority) may be productively analyzed; positing decontextualized binary dimensions is problematic.

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