Bringing Collaboration to Intelligence Analysis: A Classroom Study

Submission #1135

Thanks to all reviewers for all the positive feedback and suggested improvements to our work! Reviewers felt the paper provides a good overview of the tool and methods (2AC), clearly explained results (R3) and contributes to an interesting and important domain that is novel to CSCW (R2 & R3). Meanwhile, we have taken all suggestions and made significant revisions to the paper. We describe those below:

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| **Reviewer comments** | **Author responses** |
| **Clarification of contributions**  **AC:** Authors should clarify a more precise research question (R1 & R2 & R3) beyond the creation of a new tool. They should clarify their contributions and give more details on generalized results that would benefit to other CSCW practitioners or researchers (R1 & R3).  **2AC:** I would suggest that the authors should be better able to explain the contribution of the work beyond creating a tool for collaborative analytics.  For example, in the abstract the authors write that students "took advantage of collaboration features", "distinctions between analytic and collaborative strategies", and that the authors conclude with "implications for design" but falls short of providing detail about these contributions.  **R2:** I am missing the generalization from this one concrete case towards other similar cases such as the aforementioned research on collaborative modeling. What is it that we can learn from this particular setting? How does it relate to other settings? How is it different? Exploring those questions in the analysis and the discussion would make this paper a much stronger contribution  **R3:** It is not clear what is the generalisability of findings for other domains than intelligence analysis.  **R3:** CAnalytics is aggregating several modules (for modelling, analysis, real-time collaboration and awareness) but the features of none of the modules is novel if considered separately. | In the revision, we more clearly emphasize, in both the introduction and discussion, the contribution of this paper to understanding and supporting the coordination of complex collaborative work: (1) we documented a spontaneously adopted interleaving workflow involving switching between modeling and analysis, and characterized how such interleaving occurred as well as the consequence; (2) we distinguished three labor division strategies teams employed with our support of collaboration features, and our results implied that interleaving in the collaborative task flow requires awareness beyond team actions, but uncertainty, context of insight, and contribution value.  We have heavily restructured our result and discussion sections to make the arguments more cohesive. Among many revisions, two significant improvements include (1) we rephrased the characterization of data modeling (filtering vs. accretion) and data analysis (fact vs. inference) as momentum to drive the interleaving pattern (2) We discuss design implications for improving awareness in data uncertainty, contribution value, insight context, and thus to enable a more interleaving flow.  The paper reports specifically on a collaborative information analysis task situated in the intelligence domain, but our findings regarding team process and breakdowns address the interests of the broader CSCW community. In the revision, we rephrase our task in a broader sense and define it as a form of sensemaking which involves a complex space of information, and this paper investigates intelligence analysis as one of the most complex forms of collaborative information analysis.  We agree that the novelty of the system is not about individual functionality or advanced algorithm, but to construct an integrated analytic workspace thus to enable a collaborative, interleaving workflow, rather than. By making our contribution more articulated, we are able to clarify that our contribution is not to create a new system, but to leverage the system as a research instrument to investigate team behavior in a complex information analysis task. |
| **Literature review**  **AC:** The presented work must be more grounded in collaboration literature to highlight the novelty of the contribution (R2 & R3).  **R2:** the paper is not very well grounded in collaboration literature. There is a substantial body of work that focusses on groups collaborating on complex artifacts (e.g. work on collaborative modeling) not only in CSCW but also in other fields. The following papers provide a good overview of  the field of collaborative modeling:  *- Renger, M., Kolfschoten, G. L., & De Vreede, G. J. (2008). Challenges in collaborative modelling: a literature review and research agenda. International Journal of Simulation and Process Modelling, 4(3), 248–263.*  *- Prilla, M., Nolte, A., Herrmann, T., Kolfschoten, G., & Lukosch, S. (2013). Collaborative Usage and Development of Models: State of the Art, Challenges and Opportunities. International Journal of E-Collaboration. Special Issue on “Collaborative Usage and Development of Models,” 9(4), 1–16.*  There has also been a lot of work around collaborative writing supported by annotations or supporting awareness in collocated as well as distributed settings. I would suggest for the authors – if they did not do that already – to become familiar with this work to better situate their work in the context of this community | Thanks to R2 for directing us to a larger body of literature. We included collaboration works in similar data intensive tasks as intelligence analysis, such as collaborative modeling (Kolfschoten et al. 2008; Prilla et al. 2013), collaborative information seeking (Golovchinsky et al. 2009; Kelly et al. 2014), and collaborative visualization (Isenberg et al. 2011; Heer et al. 2008). These works provide insight in supporting teamwork with complex artifacts, yet little is known in terms of how technology-mediated collaboration occurs in a complete information analysis process, and what awareness is needed for analytic specific purposes.  We also added literature from other data intensive domains that call for an integrated environment of data modeling and analysis. For example, in interactive machine learning, researchers (Chen et al. 2016; Amershi et al. 2015) call for an all-in-one environment in which machine learning practitioners can tune model parameters and evaluate model performance in one place. In the area of visual analytics, Ware (2012) warned of the *“asymmetry in data rates”* [p.382], pointing out that visual analytic tools emphasized data flowing from systems to users far more than from users to systems. Functionalities are mostly designed to adjust data representation rather than modeling, which are in fact equally important.  Our work aligns with these efforts, and contribute to the design and evaluation of an integrated workspace in supporting information analysis tasks. Adding these literatures also makes it more clear how our paper contributes to the broader community. |
| **Clarification of method and classroom setting**  R3: In order to evaluate effectiveness of CAnalytics I would have expected a user study where some student groups are asked to use CAnalytics while other student groups use existing tools in the field for achieving the same specified task. Performances of the groups in the two conditions should have been compared. I suppose authors do not have available data for performing this comparison.  R2: There is no justification for why the authors chose the approach that they chose (surveys supported by log data) and the scales used are barely described. It is thus hard to judge if the authors approached this research in a reasonable way since both the focus of the study as well as the way that it is conducted are not clearly described. | The research setting and research design we adopted has strengths and limitations. A key strength for us is that we were able to work with motivated participants on a pretty complex collaborative task through a one-week period. Because our participants were studying our task domain, they were all aware of standard tool approaches such as ACH and Analysts Notebook. These are important strengths, particularly in our domain where expert practitioners are difficult to find at all (many work for intelligence agencies and contractors) and their time and effort is closely managed.  One of the limitations in our study design is that we were unable to conduct control group comparisons. Ethically it is difficult to assign students to education conditions that may be disadvantaged, indeed, the instructor we worked with wanted all of his students to experience the same educational opportunities. This is a direct conflict between our interest in using the classroom context as a larger-scale testbed CAnalytics, and the students/instructor interest in experiencing and learning about the effect of technology on collaborative intelligence analysis. We have strengthened and clarified our explanation of strengths and limitations of the research design. The classroom is surely a special case of the “real world”, but it is the real world relative to a lab study context. We often cannot run control conditions in workplaces.  This limitation also bears on the issue about student groups “opting out” of using our tool. Students often do not follow the recommended instructions; this is just a fact about the classroom context. Moreover, from our ethical standpoint as researchers, our participants always have the free choice to not participate at any time. Therefore, this issue was beyond our control. We reported the fact that one group did not participate. |
| **More detailed descriptions of tool usage**  AC: The analysis should strengthen how much the use of the proposed tool affected the collaboration compared to other existing tools that could have been used by students during the experiment (R2 & R3) -- may be by adding data/analysis)  R2: It would – to my understanding – also require more information about the context especially with respect to the other tools used by the students and the way they used them. It is e.g. unclear how much the students actually used the system proposed by the authors outside of the classroom, which other systems they used, how they used them and how this usage affected their collaboration as well as their usage of the author’s system. I am thus concerned that the findings that the authors derive e.g. from their log data analysis are skewed by the students not using the system as suggested by the authors.  R3: Concerning the evaluation of the tool, authors analysed uniquely user interactions with CAnalytics without considering the possible collaboration of users outside the tool. Possible user collaboration by means of other tools is not considered as it is not logged in the analysed action history.  R3: It was mentioned that one of the teams in the experiment opted for using Google Docs rather than CAnalytics for most part of the task, but this team was excluded from the data set. What was the performance achieved by this team? Where would a team fail by uniquely using GoogleDocs for sharing in real-time the documents compared to using CAnalytics? | We agree that we should add more detail on tool usage (including usage of other tools) to justify our analysis. We added more description in the beginning of the result section:  Teams had three intensive usage sessions over the week, although they could access the tool any time; two sessions were in class and one was outside class before the team report deadline. 22 teams self disclosed that they used CAnalytics as the analytic tool in the project although they were allowed to use any other tool; one team reported that they mostly used Google Doc. The reported usage was confirmed by the system log. Seven teams reported using GroupMe and other instant message outside class. They used these tools for instant communication and coordination of meeting. Ten teams reported using Google Doc. Nine of them used Google Doc only for composing the final team report and CAnalytics for analysis tasks; one team went further and used Google Doc as the main analytic tool. |
| **Discussion**  2AC: the discussion suggests that "tools shape user behaviour", or that "sensemaking activities are interleaved", but I doubt that any CSCW researchers would disagree with those statements. The later parts of the discussion get closer to making stronger points about the tool, but I'd like for the authors to provide a more direct evaluation of its strengths and weaknesses.  2AC: how well the tool supported the analytics techniques used by the class? Can the authors more strongly tie features to analytics techniques such as IEW and ACH? The authors touch on this discussion, e.g., on pg 7, but never provide detail about the features in a way that would be immediately useful to other practitioners or researchers. In particular, can the authors elaborate on what aspect of the tool coordinator's design was useful? or the notification system? These descriptions would help support the paper later on when discussing collapsable and shared views. | We have restructured our discussion to better support our arguments on interleaving workflow and awareness support to enable an interleaving workflow on a team level.  We also added the discussion to tie our system features to IEW and ACH: Both IEW and ACH aim to provide a structured approach (for modeling and analysis respectively). Yet how to transfer between the two activities is loosely defined. Our system implies a structured modeling through annotation and a structured analysis by visualizing data multiple views, and by sharing the data structure we enable a smooth switching between the twostages. Our result implies the role of multilevel modeling and analysis uncertainty in driving the switch. Based on that, we could build a scaffolding process to assist analysts in connecting data and analysis to enable a more interleaving flow. For example,  when user adds a new data object, the system could suggest possible connections to existing evidence in the context of an appropriate level of views, which is likely to help analysts discover new patterns. When a user creates a new hypothesis with uncertainty, the system could highlight associated evidence, which would prompt the analyst to re-examine the data and look for more data. Such scaffolding provides a basic structure to link stages of analytic activities that analysts can take on without imposing a specific fixed workflow. |
| **Copy editing**  AC: There is a small typos in reference [30]  R3: Figures 5 and 6 are too small. For instance, in 6(b) it is not clear how the red squares are key evidence that connects clusters. | After completing our major revision, we did a full copy edit to improve the quality of writing. We added figures with higher resolution. The layout is also changed to the new “ACM small” format. We would be happy to make any additional edits suggested by the reviewers prior to publication. |