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Intersubjective meaning making: a common ground for Human-Computer Interaction and the Learning Sciences?

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Abstract: Recent experimental and design studies of collaborative learning mediated by tabletops has foregrounded equality of interaction at the verbal and the physical level, while intersubjective learning has been back-grounded. However, the embodied interaction analysis of video footage, from ten months of single-touch screen interaction among 8-9 year-old children presented here, shows that while the constraints of single-touch screens does not support equality of interaction at the verbal and the physical level, there seems to be an intersubjective learning outcome. More precisely, the constraints of single-touch screens offer support for intersubjective meaning making in its ability of constraining the interaction. By presenting a short embodied interaction analysis of 22 seconds of collaboration, I illustrate how an embodied interaction perspective on intersubjective meaning making can tell a different story about touch-screen supported collaborative learning.

Introduction

Researchers within the domain of HCI and the LS seem to agree that interactive multi-touch technologies afford opportunities for collaboration and participation among co-present peers (Dillenbourg & Evans, 2011; Mostmans, Vleugels, & Bannier, 2012; Rick, Marshall, & Yuill, 2011). However, Yuill and Rogers (2012) argued that notwithstanding the positive affordances of multi-touch technologies, these affordances might not support smooth collaborative learning per se. In a similar fashion, Yuill and Rogers alerted researchers and interaction designers to look beyond the technological affordances of multi-touch screens, and argued that researchers and designers should scrutinize mechanisms for collaborative learning in light of social psychological theories of learning. Likewise, pedagogical considerations on how to integrate these multi-touch technologies in classrooms are still rather unusual (Higgins, Mercier, Burd & Hatch 2011), and most importantly, data from 'naturally occurring events' in classroom settings in the form of video footage or observation are limited. By providing a embodied interaction analysis of 22 seconds of children' collaboration with a single touch-screen, I suggest that Suthers (2006) concept of *technology affordances for intersubjective meaning making* could act as fruitful intersection between HCI and LS. The selected situation and perspective provides a powerful narrative on how children negotiate and cultivate a "local rationality" (Heap, 1995), using language, gestures and materials (Streeck, Goodwin & LeBaron, 2011) in their activity in front of the single-touch screens.

Related work

Stahl, Koschmann and Suthers (2006) identified three general research approaches in CSCL: experimental and conditional studies, iterative design studies, and descriptive studies. Up to now, research on collaborative learning supported by interactive tabletops has been approached primarily from the first two research perspectives. The third category of research is, however, not widely represented within CSCL research, and inspired by Suthers (2006), I argue that descriptive studies of *technology affordances for intersubjective meaning making* can inform and establish a fruitful intersection between HCI and LS.

As it is now, experimental and conditional studies on multi-touch tabletops have foregrounded that this kind of technology could support collaboration, more equal forms of participation, and speedier conflict resolution (see Davidsen & Christiansen, 2013). For example, Rick et al. (2011) presented work on three dyads working with DigiTile at the back of a classroom. Rick et al. subscribed to the common understanding regarding the affordances of interactive tabletops, i.e. awareness of each other's actions and concurrent parallel work. Finally, Rick et al. suggested that enforcing equitable physical participation could disrupt the dynamics of collaborative activities. In another paper, Harris et al. (2009) reported a difference between multi- and single-touch technologies. In this experimental setting, the children were asked to make a seating plan for their classroom, and they were provided with information about the different pupil groups in order to make a successful seating plan. Their overall conclusion being that in the single-touch setting children talked more about turn taking, and in the multi-touch setting talk was more oriented towards the task at hand. Likewise, Higgins, Mercier, Burd, and Joyce-Gibbons (2011) compared the use of multi-touch tables with paper based tasks in a tabletop environment based on numbers of touches and types of utterances. They suggested that the use of multi-touch tables was more advantageous to the creation of a joint problem solving space in collaborative learning tasks. Besides the experimental and conditional studies we find design related studies, like Yuill & Rogers (2012), Dillenbourg & Evans (2011) and Scott et al. (2003), to mention a few, which have

presented guidelines to support the integration of touch-technologies in learning settings. Scott et al. formulated 8 system guidelines for co-located collaborative work on a tabletop. Among other things, they recommended that the tabletop design should support transitions between activities, transitions between personal and group work, and simultaneous user interactions. In a similar fashion, working with design and the implementation of touch-screens for classroom teaching, Dillenbourg & Evans proposed 33 points for consideration when integrating touch tables into classroom environments. The third design framework from Yuill and Rogers proposed three mechanisms from social psychology that influence collaborative learning. These three are: *high awareness of others' actions and intentions, high control over the interface, and high availability of background information.* Additionally, Yuill & Rogers critiqued the commonly perceived affordances of how the "natural" interaction with touch-technologies influences participation and collaboration in positive ways.

To repeat, the experimental approaches taken on interaction with various touch-interfaces attended to amount of talk, number of touches in an activity and the layout of the shared workspace in co-present peer-to-peer activities. The design studies presented a fusion of abstract and tangible guidelines for the use of touch-technologies in collaborative activities. On the basis of the findings in these related papers, I suggest that descriptive studies of *technology affordances for intersubjective meaning making* can shed a different light on children's interaction with touch-screens. By applying the embodied interaction analysis we are able to uncover the methods that the children used to accomplish learning and interaction, and come to an understanding of the 'situated affordances' of the touch-screen.

Unit of analysis

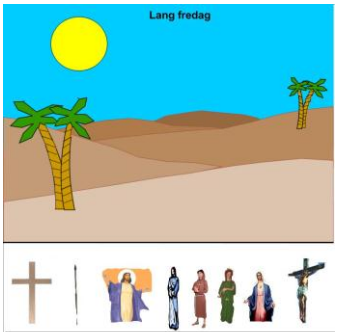
A division between HCI and LS seems a bit artificial; however, there seems to be no golden link between the two branches. Both traditions are concerned with how information and communication technologies (ICT) can support users work, learning or life in general. Several attempts have been made to bridge the gap between HCI and LS. For several years, *activity theory* has been applied as a tool for HCI research (Kaptelinin, 2006; Nardi, 1996). Before (might also be the case today) cognitive models of humans have influenced the design of ICT (see (Nardi, 1996; Winograd & Flores, 1986) for a critique of this approach). Likewise, conversation analysis (CA) and ethnomethodological research approaches has been applied as method for understanding human-computer interaction in learning, work and design (Dourish, 2004; Luff, Gilbert, & Frohlich, 1990; Suchman, 2007). Despite the rich contributions of both CA and activity theory towards a common ground, there still seems to be no real consensus between theory, method and practice of HCI and LS.

Suthers (2006) argued, and I concur, that CSCL can benefit and perhaps establish a common ground by studying *technology affordances for intersubjective meaning making*. When studying intersubjective meaning making our attention is particularly oriented towards the ways in which the participants construct, display and maintain an individual and collective perspective on the task at hand. With an *intersubjective epistemology* (Suthers, 2006) the group is the unit of analysis. The group unit of analysis should be seen as something in-between the individual and the community (Stahl, 2006). In Streeck, Goodwin and LeBaron (2011) several examples of embodied intersubjective meaning making is presented from different professional settings. In many of the examples from this collection, intersubjective meaning making is framed as a dialogue between peers, their gestures and their use of materials. Particularly, several of the papers from this collection illustrated the way in which intersubjective meaning making is developed in the situation, and how a situated 'rationality' and understanding is formed. Likewise, Koschmann and LeBaron (2002) used different examples to illustrate that learner articulation is a verbal, gestural and material phenomenon. These three semiotic resources are intertwined and mixed in the process of intersubjective meaning making. In other words, these semiotic resources inform one another and "talk back" to each other. As presented in the related work section, researchers have looked at type of utterances and number of touches at the interactive surface; however, gestures and movement are often overlooked in these studies. Interestingly, Roth (2001) among others, have showed that it *is possible to catch a glimpse of students' understanding of a given concept in the gestures they adopt even when having difficulty articulating their understanding.* Hence, descriptive studies of children's use of language, gestures and the material with interactive surfaces might provide new perspectives for both HCI and LS. As a consequence of this unit of analysis, the analysis of the co-located children interacting with a single-touchscreen is focusing on the way in which the children are making sense, while putting less emphasis on equality in terms of verbal and physical interaction. Particularly, I have studied the way in which a word, an artifact or a gesture or movement embodies the situated meaning making process. The question is what a perspective of intersubjective meaning making can bring to the intersection between HCI and LS.

An intersubjective perspective on touch-screen interaction (1)

Throughout one year, researchers collected a variety of qualitative data from two classrooms in a Danish school. Look at Davidsen and Georgsen (2010) for an introduction to the project. In this setting, single-touch screens were integrated to augment children's learning activities (2). In total, more than 150 hours of video data from 7 different positions was collected. From the body of video data, one excerpt of 22 seconds was chosen for this

paper (3). The excerpt provides a powerful narrative example of the affordances of single-touch screens for intersubjective meaning making. As the condensed analysis shows; the two pupils displayed, produced and maintained an intersubjective understanding of the activity and each other's actions through language, gestures and by using the single-touch screen. This can be described as embodied collaborative actions (Davidsen & Christiansen, 2013).



Snapshot 1. Scene

Snapshot 2.Iris (I) and Vince (V)

Iris (left) and Vince (right) are starring this situation. They were in the middle of producing a video about what happened on Good Friday. The kids wore headsets in order to listen to their production and make adjustments to their story. Before they began their collaborative activity the whole class talked about religious traditions. Iris and Vince read about Good Friday, tested their knowledge in a multiple choice quiz and rewrote the story in their own words. Finally, they had to translate their learning into a video production, using the single-touch screen. According to the teacher, it was up to the children themselves to construct a meaningful story based on the previous activities during the week. This learning material was designed by the teacher and the overall objective was to teach the children about the Christian tradition of Easter, training of language skills, and storytelling skills. For this paper, attention is paid to the final stage of the task, namely the task of retelling the story in a video production by using the figures and the scene (see snapshot 1). In this situation, the children were rehearsing their video production, reading aloud the text and moving around the objects on the screen. The children have written their account of the story about Good Friday in the booklet in Vince's right hand. The figures and scenery (snapshot 1) they have to use to make the production were designed by the teacher. Before the activity started, the teacher showed the whole class how to use the collaborative software and the video screen recorder. However, the teacher did not give any instructions as to how to carry out the collaborative work in the pairs. Vince and Iris at first discussed who should read aloud the text and move around the figures. They agreed to divide the work between them and further to change after the first rehearsal in order for both of them to try moving around objects and reading the story aloud. Vince read the text in this situation. Instantly after they finished their first rehearsal, Iris discovered that they were missing an object to cover Jesus. Hence, they agree to make a rock. This means that they are in fact reconfiguring the original scene designed by the teacher. What the children have noticed is that there is a discrepancy between the words of the story and the scenery designed by the teacher. It is a small difference that disturbs their activity. This breakdown in their translation of the story influenced their reasoning about the material they were working with. The pair' reconfiguration was based on their knowledge from the story, and this becomes the object of their intersubjective meaning making process. To sum up, this excerpt showed that interaction with single-touch screens could be a highly social activity in terms of language, gesture and manipulation of objects on the screen. Additionally, our analysis showed that the children were taking over and repairing each other's actions on the screen and no parallel action were occurring. At the beginning of this project, we saw that the single-touch condition created frustration and individual work at the shared computer (Davidsen & Georgsen, 2010). In the situation presented here, however, the pupils have developed an embodied practice of collaboration, which on the one hand allows them to push forward their own idea while still learning together.

What can we learn from this study?

As demonstrated with the embodied interaction analysis of single-touch technologies *affordances for intersubjective meaning making* this condition adds an ostensibly interesting constraint that supports collaborative learning in this setting. By the same token, the findings indicated that having to share a workspace, despite the inevitable annoyance of not having your own, can lead to the establishing of habits of turn taking, co-viewing and co-manipulating, which in the end can lead to a pattern of intersubjective learning. Hence, I argue that we need to look for mechanisms of collaboration in other settings in order to design touch technologies and learning materials that promote intersubjective meaning making. Interestingly, there is a growing body of literature on ways of studying embodied action (see Streeck, 2012) and at the same time

technologies are offering more embodied forms of interaction. Hence, it might be worthwhile to ask how a descriptive study of embodied collaborative learning can inform future guidelines for HCI design?

Notes

(1) Due to space constraints we only show the findings here, but we refer to Davidsen and Christiansen (2013) for a detailed analysis of the situation.
(2) Names of each child, teacher and the school have been changed.
(3) Visit http://people.hum.aau.dk/~jackd/CSCL13/ to view the video and transcript analysed in this paper.

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