

# The International Conference for the Learning Sciences

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## Call For Contributions For A Workshop (June 24<sup>th</sup> 2008)

### Four Eyes: Eye tracking methods in collaborative / learning research

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Eye tracking methods have been used in Cognitive Science and Human-Computer Interaction for several decades. The accuracy of gaze localization and the quality of software for analyzing gaze records have significantly improved over the years. Nowadays, these tools are reliable enough to explore complex situations, such as on-line collaborative tasks. **This workshop is about using eye tracking methods in order to deepen our understanding of cognitive and social processes in learning.** The target situations include (i) two students solving problems together (collaborative learning) and (ii) a novice learning from an expert.

Since eye tracking research on these social learning situations is rather young, the workshop will be enlarged to other relevant contexts: situations of individual learning (e.g. one student interacting with a learning material) and situations of social interaction without a learning focus (e.g. two subjects talking about characters displayed on their screen). These three different situations explain why the title of the workshop is not "collaborative learning" but "collaborative / learning". Moving from individual to social situations raise complex issues for eye tracking methods, as illustrated below:

- The analysis of complex gaze data requires deciding several semi-arbitrary thresholds, for instance for the time sampling (a time threshold to decide what is a gaze fixation), the granularity of area of interests, the delay of social interaction (when user A refers to object X, when should user B look at object B to consider that they share attention), the horizontal and vertical errors in eye detection, the processing of missing data (e.g. when learners' gaze disappears because they look at the keyboard when they are typing), ....
- To capture intrinsic aspects of expertise, one may compare the gaze patterns of experts and novices performing the same task. What are the best variables and the right granularity to compare gaze patterns? Should the experts behave "naturally" or in a didactic way if their gaze is to be reused as a model?
- In collaborative problem solving, a simple question is "do both students look at the same things at the same time?". The "same thing" is of course difficult to assess, it is more complex than the same (x, y) screen coordinates. The "same time" is actually not the same time, but the time necessary for one user to mention the object to the second user.

Despite methodological challenges, interesting results are emerging from dual eye tracking research: differences of gaze patterns between experts and novices analyzing fish movements, a correlation between gaze convergence and pair performance in problem solving, a relation between gaze divergence and conversational repairs. Other methodological issues concern the experimental studies that are conducted with eye tracking tools:

- What is the complexity of tasks that can be analyzed with eye tracking methods? The tasks used by participants vary from tangrams identification and other toy problems to collaborative concept map construction or collaborative problem solving, reflecting the traditional trade-off between experimental rigor and ecological validity.
- What is the best communication tool for studying on-line interactions? Some of us used synchronous communication while others rely on asynchronous communication. Some of us used text communication (chat tools) which increase the complexity of gaze patterns (many gazes back and forth between the task space and the chat space) compared to audio dialogues.

The workshop will address the following **objectives**:

- To compare the methods for analyzing gaze patterns: which indicators do we compute and how do we compute them, how do we choose the value of the above mentioned thresholds, how do we cope with scrolling effects, how do we analyze situations where objects moved (e.g. a whiteboard), ...
- To explore the use of machine learning techniques in detecting gaze patterns. Most top-down analyses of gaze record consist in writing software that parses gaze data and computes values. This workshop should also address bottom-up such as feeding machine learning algorithms with gaze episodes that correspond to manually selected collaborative episodes such as conflict resolution, explanation or mutual regulation or using bio-inspired modeling methods.
- To compare the socio-cognitive processes found in our various empirical studies: (a) which (independent) variables have an influence on gaze patterns; (b) how do gaze patterns predict effects measured by (dependent) variables such as group performance, learning outcomes, grounding
- To compare the complexity of tasks that can be analyzed with eye tracking methods. The tasks analyzed to date vary from toy problems to complex real-world tasks such as collaborative problem solving, reflecting the traditional trade-off between experimental rigor and ecological validity
- To compare the communication tools used for studying on-line interactions, e.g., synchronous vs. asynchronous , text vs. audio.

**To participate to this workshop**, send a 2 pages position paper to [pierre.dillenbourg@epfl.ch](mailto:pierre.dillenbourg@epfl.ch) by March 25th 2008. You may also simply send a recently published paper reporting your relevant work: this is not simply a workshop on eye tracking in general, please read the call carefully. The workshop will mostly include interactive sessions and discussions but some participants will be invited to present their work.

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