Evaluation methods for collaborative multi-touch support

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3 Deev Interaction

Elements of context

- Where do I come from?
- Which research are we doing at our lab?
- Why a tutorial on evaluation of collaborative work on tabletops?



Research Lab



- 350 researchers (full time professors, on contract researchers and PhD students)
- 9 departments of research
- 4 Affiliations to national research laboratories
 - Foton (CNRS) for optical communications
 - Latim (INSERM) for medical information processing
 - Lab-STICC (CNRS) for communications systems development and information processing
 - Marsouin for internet applications and analyses of use
- Marconi Prize 2005 (turbocodes)
- SPIE Award 2006 (optics)
- Inserm Prize 2006 (Medical Imagery)
- One representative at the French Académie des sciences



Research lab





ATOL (Aeronautics technico-operational lab) THALES, Telecom Bretagne, French Navy School

Why a tutorial?

- Achievement of several research projects contributing to the elicitation of a generic method of cooperation analysis and evaluation
- Method robust and generic enough to be shared and challenged with specialists (please interact!)

Tutorial

Main goals of evaluation
Main elements of methodology
Tools
Cooperation analysis / Use case
Results

Main goals of Evaluation











- Interactive tabletop / multi-users
- No explicit constraints on workflows
- One expert role by user





- Interactive tabletop / multi-users
- No explicit constraints on workflows
- One expert role by user









Where is the problem (if any)?



Would this one be more appropriate for the cooperative task ?



How to deal with a new cooperation process or to benchmark an existing one?





Simply transposing an application on an interactive surface is obviously not enough



- Facilitating cooperative work on cooperative work on interactive tabletop:
 - while modeling cooperation on the tabletop in order to better understand the phenomenas
 - while inferring recommendations for the design of such interfaces





Ergonomics for cooperation

- How to caracterize cooperation?
- How to describe cooperative / team behaviors around a tabletop?

Aiming at

- designing
- re-designing
- adapting (on-line analysis)

Theoretical background

Cooperation

- Cooperation is a task by itself (Klein 2003, Hoc 2001)
- Need for understanding and adapting to "cooperation patterns"
- Need for identifying "cooperative modes" to discriminate and assist teams of different kind

Tabletops and cooperation

Large surfaces or multiple surfaces naturally support cooperative tasks

Cooperation around collocated surfaces is not as standardized and mediated as most of CSCW approaches How to represent cooperative behaviors (around a tabletop)?

Space

• Surface, space and topology



Montferrat 2009







S.Scott 2004

... but is it enough?

Multiple spaces of representation

Surface, space and topology

Acts of cooperation

- Intentions
- Tasks



EXT-maintainance Maintaining representation of external elements (situation, context, environment)

INT-goal-maintainance Maintaining internal representation of team goals

INT-plan-maintainance Maintaining internal representation of team plans

INT-role-alloc-maintainance Maintaining internal representation on roles allocation **EXT-elaboration**

Elaborating representation of external elements (situation, context, environment)

INT-goal-elaboration Elaborating internal representations of team goals

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roles allocation

(Hoc, 2001)

I check you have the same sinance representation of external entation of external situation as I have (situation, context, environment)

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I check you share a common or maintainance representation of our ternal representation on respective roles in the estallocation team (or task) **EXT-elaboration**

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Elaborating internal representation on roles allocation

Intentions and communication

	Give suggestions, ideas while respecting others' ones
2	Give opinions, evaluates, express wishes and feelings
3	Give orientations, information, clarify, elicit, confirm
4	Ask for orientations, informations, look for confirmations
5	Ask for opinions, expect for others's evaluations to analyse them
6	Ask for ideas and suggestions, directions and possible actions
Intentions and communication

- Information
- Order
- Suggestion
- Explanation
- Attention
- Acknowledge

(Chéné & al., to appear)

Task model



Tasks



Space and topology



Gestures as non verbal communication

- Co-verbal (deictic)
- Quasi-linguistic
- Synchronization
- Manipulation

(McNeill 2005, Cosnier 96)

Back to our first example ...

Tasks



Back to our first example ...

- Extraction of patterns of cooperation
- Proposal of recommendations

State of availability of operators

Visual reification of responsibilities and actions done in different spaces

Area dedicated to common reflection









Observation methods

- Observe to understand ...
- ... Understand to enhance
- No intrusion (or as few as possible)
- Performance is not always the key

Observation tools

The Observer XT is the professional and user-friendly event logging software for the collection, analysis, and presentation of observational data.



The Observer

Setup







Analyze



The Observer XT First step: setup 1/4



Synchronization of information sources

The Observer XT First step: setup 2/4

Coding scheme

Subject

Behaviour

Modifier

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The Observer XT First step: setup 3/4

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🕺 Ressources operator	s

Behaviours

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The Observer XT First step: setup 4/4

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Cooperation analysis Use Case

Methodology

Our method of evaluation of cooperation relies on the identification and measurement of activity along 4 main dimensions involved in cooperative work around tabletops. From these measures, we can get a representation of cooperation and determine whether it is efficient and satisfying. If not, recommendation on system and organization are proposed.

The 4 dimensions are :

Shared mental representation within the team Team behavior and cohesiveness Relevance of intra team verbal exchanges User experience of cooperation

Presentation of the Collagis use case

Collagis^I project is a research project aiming at developing a generic software framework supporting an interactive device for cooperative work around geographic data.

- Multiple users
- GIS (geographic information system)

Collagis configuration

The application is a serious game simulating a context and process of decision making. Two operators cooperate in a collocated dual screen system to decide about the location of a new healthcare center, depending on the existing ones and sources of risk (polluting / Seveso factories and sites) present on the area.





Collagis configuraion

4 cameras (l camera/operator, l global, l backup)

Acquisition of operators on the screen (logs)

I hour experiment

Questionnaire pre (profile) and post (cooperation evaluation) experiment



Collagis functions

Map



Retrieving information on sites (factories / hospitals)



Collagis functions

Risk propagation area / intervention







Collagis functions

Locating the new center of healthcare



« In the area from Nice to Marseille, the experts have detected an overpassing number of dangerous factories when compared with the existing generic or specialized healthcare centers. It is urgent to build a new one to fill this gap. Your objective is to find the optimal location while taking into account the existing.»

Shared mental representation

Representation of external situation (situation, context, environment) Representation of teams goals Representation of teams plans Representation of role allocation

Example of elaboration :



Shared mental representation

Maintenance or elaboration

Maintenance of common ground is defined as a unique communication followed by an acknowledge. Transmitted information is in affordance with receiver's mental model and he/she integrates it immediately.

While elaboration is a sequence of alternated talks with surprises and conflicts between operators, that ends with a final agreement (Hoc 2001 - acts of cooperation categories)



Loops and common ground

When coding dialog between operators, we acquire start time and end time of information exchanges. This corresponds to a maintenance or elaboration loop.

If there is no observation of an ending loop, it remains open and it is considered as a failure in setting a common ground between the two operators. Otherwise we consider the loop is closed and this is a success (Chauvin & al. 2010)



Example of "open loop"

Loops duration

We measure the duration of closed maintenance loops or elaboration (success loops). In this case, we consider that the shorter the loops will be the more efficient they will be for common ground setting. Operators reach the target with a minimal effort and a minimal duration (ISO 9241-11)

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Common ground maintenance

Giving acknowledges indicates maintenance of the common ground. It avoids all misunderstanding during information exchanges between operators. On the contrary, asking for acknowledge is a sign of the emitter doubting about the sharing of his/her representation with his/her receiver. Consequently, common ground can be supposed to be degraded (Chauvin & al. 2010)







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Team behavior and anticipation

Two behavioral profiles can be identified: reactive behaviors and proactive behaviors. A proactive behavior supposes a good knowledge of operators about the task to be achieved, the work organization and team and mutual competencies. This allows to bring the necessary and relevant information to the other operator before he/she asks for.









Team behavior and anticipation

With a reactive behavior, an operator asks to his/her partner information he/she needs to achieve the task. This implies an extra delay in task achievement and/or a cognitive overload.







Hierarchical links and operators roles

To check about the actual hierarchical links between operators, we rely on several criteria that are coded within Noldus: emission or requests for orders, emission or requests fo suggestion, frequency of intervention and decision making.

We thus evaluate hierarchical links thanks to the orders and suggestions. Emission of orders is a direct sign of authority and leadership. Asking for directions and orders represents the opposite.

Hierarchical links and operators roles (II)

Suggestions gather communications related to opinions, recommendations and advices. Emitting suggestions is considered as a supportive behavior, while asking for suggestion reveals doubts and need for help on the emitter side (Chauvin & al. 2010)



Example of emission of order

Accuracy of exchanges

We gather in explanations (requested or given) all communication acts such as clarification, tuning, repetititon, correction and justification. We consider explanations to be correlated to the level of soudness and accuracy of exchanges. Requests for explanation express a problem of mutual understanding between operators (Chauvin et al, 2010).



Exemple
Attention and focus

Need for (or lack of) collaboration / cooperation can be detected through requests for attention. We suppose that without such requests, attention can be considered as satisfying (use of eyetrakers information should allow to refine this approach) (Chauvin et al, 2010).



Gesture and gaze

We focus on gaze and pointing gestures (Ekman et Friesen (1969), McNeill (1992)). Gazes can be considered as regulating gestures / acts. Gazes and gestures (e.g. nodding) accompany the interaction (as mumbling can accompany dialog).

Pointing gestures are deictic and indicate somehing in the environment.







Content of exchanges

The set of concepts addressed by the exchanges between operators is gathered and analyzed. This allows to deal with the "What?". These concepts may be analyzed while making reference to the domain knowledge of experts or attached to the current task.

To summarize



Post experiment group evaluation

Questionnaire about:

- Information sharing
- Coordination amongst actors
- Group communication
- Individual engagement
- Team cohesion

(qualitative) results

Time of scenario execution

Time of scenario execution



Cooperative "mode"

Frequency of elaboration and maintenance acts



Loops

Number of open and closed loops

Mean time of closed loops







Mean time of maintenance closed loops

Orders, suggestions, precision

orders



precision

Apport ou demande d'explications







Gaze and gesture

nature of pointing

gaze and pointing



Condition d'apparition du pointage



nature of gaze



Group profiles

	group 2	group 4	group5
anticip.	proactive	proactive	proactive
hierarc.	no link / factory decide	no link / factory decide	no link / health decide
precision	good level of understanding	average	altered
need collab.	satisfying	satisfying	satisfying
gestures	few	few	gazes >> point.

User experience Sharing information



User experience Coordination



Only oral exchanges on state of progress No structure for the project

User experience Communication



Usr experience Cohesiveness and Engagement



Nothing to declare



Thanks for attention!