

# Understanding Team Design Communication through the Designer's eye: a Descriptive-Analytic Approach

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## Abstract

The present study is an example of an empirical design research project based on design teams. Our main goal is to describe, understand and analyze the communication processes which take place inside a design team working on a design project for a short period of time. This paper presents the main observations and results of two case studies based on two design fields: Architecture and Graphic design. The paper's contribution lies on the methodology used, combining qualitative and quantitative methods of analysis, and involving the designers' point of view at various steps of the research process. In this way, we consider the value of this study twofold: first, it served as a 'vehicle of communication' between the research team and the design team and second, the structured methodology followed taking into consideration recognized methods, such as Linkography, and adapting them to the communication focus of this study.

## Keywords

Design methodology, Team design, Communication, Case studies, Content, Structure, Linkography

The evolution of Team Design research can be marked by two main landmarks, which changed the view of how to focus on design processes: the Delft protocols workshop in 1994 (Cross, Christiaans & Dorst, 1994) and the DTRS7 common dataset analysis (McDonnell & Lloyd, 2009). In the two corresponding collections of papers written by diverse authors focusing on a big range of methodologies, a common tendency can be seen: the more complex the design process gets, the more effort is required by the Design research community to describe and analyze this complexity.

A major aspect of design complexity lies on the fact that design is nowadays mostly carried out by teams, including also others than the designers (e.g., the users) and consisting of people with different backgrounds and disciplines. This has generated an heterogeneity in the communication processes emerging during the meetings in which everyone involved in a specific design project has to be present but is not necessarily active and, even worse, not necessarily 'effective' for the production of the final product. As effectiveness we understand the relation of individual contributions at a cognitive-communicative level with the final team design result.

In order to judge this effectiveness, which additionally forms the basis of the team's best communication practices, an external eye, rather than the designers', is needed. At the same time, the designers' eye on the research processes is the other half of the judgment as they are the ones who know the specific characteristics of their work better than anyone else and the requirements they have to confront also outside the design meetings. For this reason we consider their involvement in the methodology presented below as an essential aspect of the research design process.

## Method

## Research questions

Having as main goal to describe the effective communication processes taking place in a team of designers, in a brief, as the projects considered were also brief, and communicable way, we posed the following research questions:

- 1) Are there moments in the team design interaction that can be characterized as more effective than others?
- 2) Which aspects of communication are relevant to this effectiveness?
- 3) Are there significant correlations between them?

## Participants

The data used for this study is taken from two teams of professional designers at work on real design projects. Both projects had a short overall duration and were completed with the achievement of their goals, i.e., the creation of specific design objects.

In the first case, a team of 6 architects designed a Cultural Center for an international contest. This project ran for 4 months and generated a full submission for the contest, in the form of plans and model pictures. Overall, this project included 6 team design sessions for a total of nearly 10.5 hours. In the second case, a team of 2 graphic designers and their client designed a multiple-content book, authored by the client. The project ran for 3 months, and generated as final output a book on a famous film director. This project included 6 team design sessions for a total of nearly 8.5 hours. For the remainder of this paper the cases will be referred to as case A (for Architecture) and case B (for Book).

## Data collection

According to Nardi (2006), in order to best describe an activity taking place in a specific context the following methodological implications have to be taken into consideration:

- A research timeframe long enough to understand actors' objects, which in Activity Theory also represent the goals-objectives (Leontev, 1979);
- A broad data collection, that allows paying attention to broad patterns of activity;
- The use of a varied set of data collection and analysis techniques;
- A commitment to understanding things from the actors' points of view.

Following the above principles, our method of analysis can be summarized in four steps, which are presented and discussed in more detail in the following paragraphs:

1. Following the participants during the whole duration of the project, understanding its context and specific features from the point of view of the professional life of the designers. In particular, we audio- and video recorded all team meetings for later analysis.
2. Focusing on the activity of participants both as individual contributions (moves) and team processes and interactions, namely by coding the recorded protocol in *cognitive-communicative acts* and then segmenting the coded protocol in *design episodes*.
3. Analyzing design episodes according to a number of parameters, blending different design analysis methodologies.
4. Discussing the content, structure and significance of these episodes with the designers themselves, in order to reach a level of consensus on their own communication processes.

### **STEP 1: Starting from the beginning**

Following the principles stated above, to the purposes of this research study, we contacted designers which were about to start new projects with a duration compatible with the time constraints of our research. We then engaged the participants in a conversation about the project, asking them to present the project and identify its specific features from two points of view: the project itself (e.g., the peculiar kind of content for the book in Case B), or its position in the professional career of the involved designers (e.g., the fact that it was the first submission to an international contest for the team of Case A). Collecting such information was important for defining the framework of the design projects, along with the frame of mind of involved designers. This was indeed central for being later able to interpret their feedback on the analysis and to identify the relevant design features of the output.

We then video-recorded all design meetings. While large part of the activities carried out within design projects are individual activities, when a team is involved, design meetings represent project milestones: it is there when individual contributions come together and are shared and blended, when tasks are assigned, when ideas must find effective expression and representation in order to become shared and actually contribute to the project.

## **STEP 2: Segmenting episodes and coding acts**

Following the nature of the projects, video recordings were organized in *design sessions*. Our main unit of analysis was the *episode*, intended as a significant temporal segment of a design session. Other scholars in Design Research have also chosen design episodes as the main units of analysis (in Cross, Christiaans & Dorst, 1996; McDonnell & Lloyd, 2009). In short, the granularity of episodes and the criteria for their definition (i.e., for segmentation) remain under-studied issues both in Conversational Analysis and in Design Research.

Our definition of episode is very similar to Wheatley's (1995) *topic type*, which refers to "a unit of talk that shares some of the attributes of Levinson's *activity types* and discourse *topics*" (in Firth, 1995, p. 379). The equivalent of our design episodes in discourse analysis would be what Sinclair and Coulthard (1992) call *transactions*. However, in our study we did not follow strictly these authors' indications for two reasons: (a) because of the lack of analysis of the transactions' main components, i.e. *exchanges and sequences*; and (b) because of the so-called "anarchy" in the design discourse, due to an "opportunistic movement between topics" (McDonnell, 2009, p.252).

Given this situation, we defined two criteria for the distinction between episodes: (a) topic-shift and (b) goal-shift. This means that each time that an explicit introduction of a new topic happens, or a new goal emerges during the interaction, a new episode begins.

Each video-recorded session was therefore transformed into communication protocols, which were composed of design episodes, each composed by several moves. *Moves* refer to each participant's contributions in the interaction and correspond to the smaller unit of analysis after acts (Sinclair & Coulthard, 1992). As these authors declare "a move boundary signals a change in the speaker who is composing/creating the discourse, and therefore a move boundary is a potential change in the direction of the discourse" (p. 23). In Design Research, Goldschmidt's (1992) description is one of the most representative: "The meaning of a 'move' in designing is akin to its meaning in chess: a design move is a step, an act, an operation, which transforms the design situation relative to the state in which it was prior to that move" (p. 72). As for episodes, for the granularity of the moves we again consider two main criteria of change of state: topic-shift and goal-shift. The difference here is that for moves, topics refer to individual representations and goals to person-derived goals.

Each move was then tagged with a *theme* and a *keyword*. This protocol, and not a full transcript, was used for coding and analysis.

Finally, each move was coded according to a framework of cognitive-communicative acts, to which the moves correspond in a design interaction. Each act is described by an action (e.g., *present*) and an

object (e.g., *data*). The framework included the categories presented in Table 1. An example of a coded episode can be seen in Figure 1.

		<b>Object</b>					
				<i>Data</i>	<i>Solution</i>	<i>Plan</i>	<i>Goal</i>
<b>Action</b>	<i>Present</i>	make generate	explicit,	P(d)	P(s)	P(p)	P(g)
	<i>Analyze</i>	clarify, explain		A(d)	A(s)	A(p)	A(g)
	<i>Evaluate</i>	assess, justify		E(d)	E(s)	E(p)	E(g)
	<i>Decide</i>	give final agreement on		-	D(s)	D(p)	-

Table 1 Coding framework for cognitive-communicative acts

Line	time	theme	keyword	P1	P2	P3	P4	P5	P6
128	32.35	performance hall	sphere-like shape			P(s)			
129	33.00	work-progress	functionality	P(p)					
130	33.30	performance hall	sphere-like shape				E(s)		
131	33.41	sphere-like shape	internal structure			A(s)?			
132	33.43	sphere-like shape	internal structure				A(s)		
133	33.47	sphere-like shape	internal structure			A(s)?			
134	33.57	sphere-like shape	internal structure				A(s)		
135	34.05	space organization	internal structure			A(s)?			
136	34.32	work-progress					P(p)		
137	34.35	space organization	boxes-surroundings			E(p)			
138	34.40	space organization	direction			A(p)			
139	35.04	space organization	internal-external			P(p)?			
140	35.20	space organization	direction	A(p)					
141	35.45	space organization	ticket	E(p)					
142	35.50	space organization	ticket				A(d)		
143	35.54	space organization	ticket			A(p)?			
144	35.57	space organization	ticket				P(d)		
145	36.00	space organization	ticket	P(p)					
146	36.10	ticket	functionality			E(p)			
147	36.15	space organization	multiple accesses			P(s)			
148	36.26	space organization	multiple accesses			A(s)			
149	36.35	multiple accesses	underpass					A(s)	
150	36.38	multiple accesses	roads			A(s)			
151	36.47	multiple accesses	lights	P(s)					
152	36.50	multiple accesses	lights			A(s)			
153	37.05	structure	space organization	P(p)					
154	37.12	structure	space organization			E(p)			
155	37.34	structure	sphere-like shape	P(s)					
156	37.48	sphere-like shape	costs			E(s)			
157	38.05	sphere-like shape	costs	E(s)					
158	38.15	sphere-like shape	costs			E(s)			
159	38.20	sphere-like shape	costs	E(s)					
160	38.23	sphere-like shape	costs			E(s)			

Figure 1 A coded episode from Case A

**STEP 3: Episode analysis**

The main focus of this paper is on communication episodes as main unit of analysis. This was operationalized as a threefold analysis, which included their *content*, *structure* and *relevance*.

**Content.** As we already implied above, content refers to two main entities, distinguished for the purposes of this study: the *theme* and the *keyword*. The *theme* refers to the context or to the common ground of the discourse (Hajicova, Hall Partee & Sgall, 1998), whereas the notion of *keyword* was created to refer to Akin’s (1986) *thing* or *relationship* to which a move is focused on. The theme is related to the topic in the following way (Katz, 1980): “The notion of a discourse topic is that of the common theme of the previous sentences in the discourse, the topic carried from sentence to sentence as the subject of their predication” (p. 26). Perfetti & Goldman (1974) add: “By thematisation we mean the discourse process by which a referent comes to be developed as the central subject of the discourse” (p. 71). In conclusion and according to our use of the notions *topic* and *theme*, topic refers to a more general conversational object, usually composed of many themes, which in their turn consist of at least one referent – what we call *keyword* for reasons of simplification- which has become part of the common ground of the speakers.

**Structure.** As far as the structure of an episode is concerned, we were mainly interested in:

- 1) *Time duration*: absolute and in relation to the whole session.
- 2) *Number of active participants*: absolute number and in relation to the total number of team members present during the session.
- 3) Identification of *the person(s) who initiates and finalizes* the episode (related to roles).
- 4) *Number and type of cognitive acts* belonging to the episode.
- 5) *Number of links* among identical keywords inside an episode; this measure is an adaptation of the method of linkography which is already applied on team design protocols (e.g., Goldschmidt & Weil, 1998). Our adaptation consists in considering only inter-episode links, taking therefore into consideration that the topic currently under discussion, which is usually the same during one episode, promotes the use of certain keywords and prevents others.
- 6) the *type of links* belonging to an episode. We mainly distinguish between two types of links: neutral and relevant links. Relevant links in this study are those which link between relevant keywords, i.e. keywords directly referring to aspects of the final design object.

**Relevance.** To the purposes of this research study, we defined relevance as the relationship between episodes and the final design product. Conceptually, an episode is relevant to the design project if it provided ideas, features or decisions that were eventually positively reflected in the final product. In order to determine relevance, after the design projects were concluded, we had a special session with the lead designers, and asked them to select relevant features of the final design product from the list of keywords from our protocols (see below). This served as a benchmark for the analysis. Relevance can refer either to content or to structure. In the case of content, we consider the *relevance of keywords* in relation to the final product; in the case of structure, we consider *relevance of links* in relation to the number of linked relevant keywords inside an episode. Formulas are presented in Figure 2.

$\frac{\text{\# relevant keywords in episode}}{\text{\# keywords in episode}}$	$\frac{\text{\# links to/from relevant keywords in episode}}{\text{\# links in episode}}$
<i>Formula for relevance of keywords (content)</i>	<i>Formula for relevance of links (structure)</i>

Figure 2 Formulas of “relevance” used in the study

#### **STEP 4: Feeding back to the designers**

The participant designers were involved in the research process mainly in two ways: deciding on the relevance of the keywords and discussing the choice of some episodes as more relevant than the others.

#### **Deciding on the relevance of the keywords**

After having tagged each one of the protocol's moves with a keyword, we came up with a list of all the keywords referred during the six sessions of each project and their occurrence in the whole protocol. In the following table we show the keywords with the highest occurrence of both analyzed projects.

<b>CASE A: Architects</b>		<b>CASE B: Graphic designers</b>	
space	access	images	cover
shape	building	contents	texts
dimensions	texture	dimensions	pages
performance hall	patterns	structure	translations
wrapping	internal-external	corrections	order
piece of city	stone	history	poetries
volume	«souk»	report cards	family images
empty space	continuity	authors	PDF
underground	route	index	costs
facade	square	position	titles
quality	symbols	scripts	form
surface	external	material	color
internal	green	father	notes
costs	requisites	format	tetralogy
materials	structure	images	interviews

Table 2 Some of the keywords emerged

The second step consisted of a grounded analysis (Glaser & Strauss, 1967) based on the produced list of keywords and their corresponding theme, according to the already coded protocol. This kind of qualitative analysis permits both to define categories as emerging from the data and to classify contents into these categories and not according to pre-defined and frequently biased taxonomies. Finally three big categories emerged for both projects, named: Problems, Solutions and Constraints-Requirements. In Case A, another small category was added called 'Examples'. Solutions were further categorized as belonging to one of the problems.

In the third step, the responsible of each design team was asked to help the research team in defining the integration of the keywords emerged into the final product. This co-decision turned out to be necessary, especially in the case of Architects as their final product was a projected model and not a physical building. During our discussions we mainly defined the use or non-use of each solution proposed, which of the requirements-constraints were related to which solutions and finally, only in Case A, which of the examples emerged during the discussions served as base for which implemented solution. Having done all that, we were able to determine the relevance of the problems, solutions, examples and requirements-constraints discussed throughout the projects.

## Feedback to and from the designers

Once the most significant episodes were selected, a Focus Group session was organized with the design teams. The structure of these sessions followed the basic steps of an ordinary Focus Group meeting (Morgan & Krueger, 1998); however, the content of discussion was formed on the basis of Video Interaction Analysis methods (Jordan & Henderson, 1995).

More precisely, we showed the team the video clips of the episodes we selected and we discussed their content and structure, the other two measures of our analysis. Some representative issues of discussion brought up during the Focus Group sessions are:

- What is happening in this episode?
- How would you evaluate the team's communication in this episode?
- Is this episode relevant to the final solution? If so, how?

One of our goals was also to give and get feedback on the types and identification of the 14 cognitive-communicative acts we selected as codes for the protocol construction. We consider that the predominance and sequence of these acts gives a first image of the team communication dynamics constructed around a complex cognitive object, such as the design object. Moreover, the categories selected are understandable and communicable also to non-experts. However, we could not be sure about the adequacy of our selection until we tried out a test of inter-rater reliability having as raters one of the authors and 5 members of team A. The results were satisfying ( $K=0,65$ ) considering also the difficulty of agreement in such types of coding schemes (Goldschmidt & Weil, 1998), and the lack of clear explanations for each category. The improvement of the coding scheme is one of our future goals.

## Results

From the analysis described in the previous section, a respectable amount of data regarding team communication processes emerged. However, their treatment and statistic analysis was adapted to this study's goal and more precisely to give answers to the following main questions:

- Which are the characteristics of the episode with the highest structure and content relevance?
- Is there a significant correlation between these characteristics?

First of all, we needed to know which of the 206 episodes in total (of both cases) were more relevant in terms of content and structure. In order to do that, we selected all cases which appeared having very high structure and content relevance at the same time. Our analysis turned out with 7 out of 85 most relevant episodes for Case A and 12 out of 121 for Case B. These episodes were the ones which formed the base of discussion with the two teams during the focus group meetings.

Secondly, we were interested in describing these highly relevant episodes using the measures discussed previously. Table 3 shows some general characteristics we considered representative of the team communication process such as the session in which the episode appears in, the number of active participants, the time proportion that the episode occupies in the whole session etc.

Case	session	active participants	duration in session	first speaker	second speaker	last speaker	total acts	predominant act
A	2	4 of 5	12.7%	3	2	3	33	A(s), P(s)
A	3	4 of 6	4.8%	1	2	2	26	A(s)
A	3	5 of 7	6.4%	1	2	2	31	P(d)

A	3	3 of 6	7.4%	1	4	3	27	E(s)
A	4	4 of 6	7.7%	3	1	3	25	P(s)
A	4	4 of 6	8.2%	1	3	1	30	E(s)
A	6	4 of 5	9.9%	1	4	1	25	P(s)
B	1	2 of 3	8.4%	1	2	1	22	A(d)
B	1	3 of 3	2.4%	1	2	2	16	E(p), P(p)
B	1	2 of 3	4.1%	1	2	1	19	E(d)
B	2	3 of 3	13.0%	1	2	2	13	E(p), A(p), A(d)
B	3	2 of 2	5.0%	1	2	2	10	-
B	3	2 of 2	4.8%	1	2	2	19	P(s)
B	4	2 of 3	7.4%	2	1	1	25	P(s)
B	5	2 of 3	3.3%	1	2	1	14	A(d), P(s)
B	5	2 of 3	8.4%	1	2	1	32	E(s),P(s)
B	6	2 of 2	2.3%	1	2	1	22	P(s)
B	6	2 of 2	4.2%	1	2	1	16	P(s)
B	6	2 of 2	2.5%	1	2	2	10	-

Table 3 Some descriptive characteristics of the most relevant episodes

These descriptives were used as a “vehicle of communication” between us and the designers at the time we wanted to make them reflect on their communication processes. We also considered necessary to give them a more detailed image of their use of cognitive-communicative acts during these highly relevant instances of the project. Figure 3 shows the distribution of the appearing acts in both cases always inside the 19 episodes’ time.

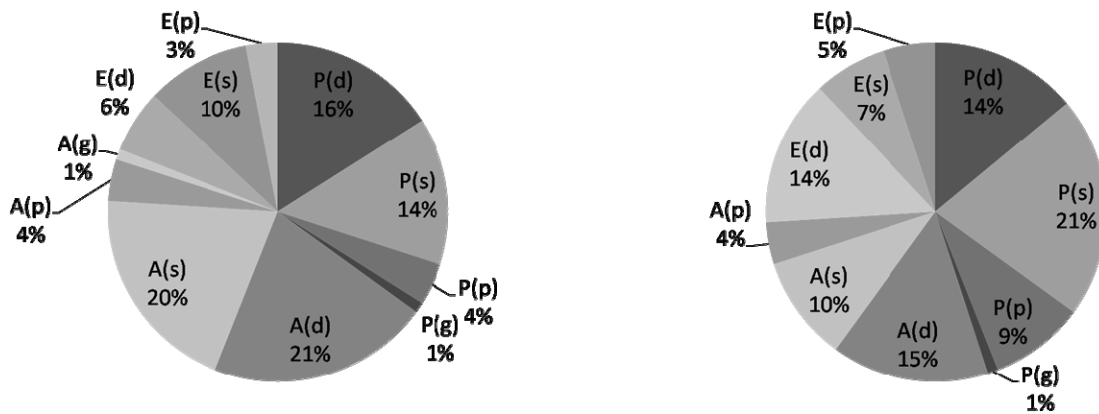


Figure 3 The distribution of the appearing acts during the most relevant episodes in Case A and Case B

Significance of correlations was also examined in order to check the reliability of the methods used. Table 4 shows some of the significant correlations emerged between the variables used.



	Duration in session	Active participants	First speaker	Total acts	Total links	Content relevance	Structure relevance
Duration in session	-						
Active participants	.035	-					
First speaker	.139*	-.091	-				
Total acts	<b>.851**</b>	.119	<b>.154*</b>	-			
Total links	<b>.310**</b>	<b>.425**</b>	-.131	<b>.458**</b>	-		
Content relevance	-.103	<b>.377**</b>	<b>-.223**</b>	-.067	<b>.368**</b>	-	
Structure relevance	-.027	<b>.310**</b>	<b>-.135</b>	.014	<b>.303**</b>	<b>.791**</b>	-

Table 4 Pearson correlations for the sample N= 206 (\* p > 0.05, \*\* p> 0.01)

## Discussion

First of all, some interesting comparisons between the two cases emerge regarding their relevant episodes. The distribution of the relevant episodes among the sessions doesn't seem to follow any general rules. We can assume that it depends on the very specific characteristics of the project and the team. In Case A, for example, session 5 was dedicated to the application of solutions already discussed and this could explain why relevant episodes do not emerge. In Case B, the first and last sessions seem to be the most relevant: the first session was dedicated to the explanation of the project from the client to the designers and the final solutions were mostly presented in the last 2 sessions, after the complexity of the material was more or less resolved.

It is interesting that in all relevant episodes half or more of the participants are active. However, our small sample does not allow considering this observation as a pre-condition. Also, the type of participation has to be controlled before getting to generalizations.

The length of duration of these episodes, compared to the total duration of the corresponding session, does not seem to be significant as it is also confirmed by Table 4.

As far as the identity of the first, second and last speaker is concerned, it is interesting to notice that in all cases the second speaker is different than the first. Given that in our study 'speaker' corresponds to a person who makes a move, it is possible that a sequence is composed of more than one moves of the same speaker. Another interesting observation is that the last speaker almost always, in 17 out of 19 cases, corresponds to one of the two initiators of the episode.

No reliable observation can be made about the influence of the number of total acts, as this measure is significantly subject to the episode's duration as we can see on Table 4.

Nonetheless, the type of cognitive-communicative acts inside the episode seem to have some comparable characteristics between the two cases: a) in each episode distribution, 'solution' is the main action's object in both cases, and b) in all episode distribution, the action of 'analysis' is most predominant one and together with the action of 'evaluation' overpass the action of 'present'. This is

interesting if we consider that in Case A the most frequent act is 'present' rather than 'analyze' and in Case B the most predominant object is 'data' instead of 'solution'.

The most significant correlations, marked in bold in Table 4, turn out to be:

- Between Content Relevance and Structure Relevance: the more relevance there is between the content of the discussion and the final design product, the more this content is linked with other episodes before and/or after the episode under analysis.
- Between Total links and both Relevances: this is a confirmation that the method of Linkography is a representative measure of both the content and the structure of a design process.
- Between Total links and Active participants: the more participants are active in the episode, the more links in the structure of the process are created.

## Conclusions

The present study's goal was to construct and apply a method of description and analysis of the team design processes sufficient and adequate enough to respond to two requirements: (a) to shed light onto the communication processes of two diverse teams designing a specific design object in a short-time period and (b) to describe and analyze this process in a meaningful way for the designers involved.

Taking into consideration that this paper forms only a part of an ongoing research on team design processes, we should mention that the present focus is limited to some macro-observations without getting into further detail which we consider to be necessary in order to be more precise in our results and communications to the designers. In addition, this paper's contribution should be seen considering the notable lack of precise and efficient methods in both fields of Small Team Communication and Team Design Research. Regarding the limited literature and confrontation, especially in the latter field, we conclude with mentioning our contributions and implications for further work.

Regarding the method used, it can be broadly considered as an extension of the Linkography method (Goldschmidt, 1992; Goldschmidt & Weil, 1998). Our innovation lies on the following facts: a) we didn't transcribe the whole discourse; instead, we coded the whole communication that took place for both studies creating in this way an extended protocol to work on, b) our coding relies entirely on natural setting communications – no thinking aloud protocols were used and c) the links were constructed between keywords to which the moves were referred; these keywords sometimes were uttered exactly the same by the designers and some other times we had to infer them from the context. In this way, we gave a pragmatic dimension to the concepts used and, as a result, their connection with the final characteristics of the design object made more sense.

Moreover, the combination of the method described above with other methods deriving from the Cognitive Ergonomics field, regarding the use of the coding scheme, and from the Communication field, regarding the granulation of the episodes and their discursive structure, resulted in the production of various observations, with a high significance in a great number of them. Finally, the introduction of the measure of 'relevance' and its double definition as 'content relevance' and 'structure relevance' was proven efficient at the time of selecting a small number of episodes as more representative of the team design process. A constraint of this research device is the need for active involvement of the participant designers and their collaboration during the entire research timeline.

Future work includes adding more cases from other design fields, further controlling the reliability of the coding and segmenting methods and analyzing the most relevant episodes also from dialectic and argumentative points of view so that a more detailed view of the micro-communication processes can be given. Participant roles is another issue not thoroughly considered by this paper and which needs

further characterization regarding not only the behavioral aspects but also the epistemic dimensions (as in Baker et al., 2009).

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