

Design conversations in the interconnected HIS

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Abstract. To ideate, to exteriorize a concept, designers talk and put qualitative and ambiguous mental images in external representations. Verbalization on its own or combined with these representations drives ideation and is the most common means of externalizing design intentions in collaborative settings. This paper presents in detail the different elements of the *design conversation* in a remote setting: Collaborative Ideation Loops, Collaborative Conversations and Collaborative Moving. They occurred while using the interconnected Hybrid Ideation Space (HIS) in the context of a multidisciplinary ad-hoc project between two universities located in different countries. We ran a research protocol in the format of a design *charrette* where two teams (team a: two architecture students, team b: two industrial design students) participated in the ideation of a bus shelter. This case study shows the relevance in particular of these elements of design conversations, as methodological tools to better assess and understand collaborative ideation process using computer-mediated collaborative environments.

Keywords. *Design conversations; Collaborative Ideation Loop; process-based assessment; methodological tool; interconnected Hybrid Ideation Space.*

1. Introduction

“Yeah, well, here it looks kinda high; I was thinking more about this high” is a typical verbal communication between designers during collaborative ideation (CI). To assess CI we have to assess design conversation. Yet design conversation will be affected by the logic of the tool that is used. Therefore we opted to observe design conversation in the specific setting of the interconnected Hybrid Ideation Space (HIS) because it appears to be transparent to the logic of design, as it has shown in the past (Dorta et al. 2009; 2010) to better support ideation as well as remote and local CI. The HIS (Dorta 2007) is a hybrid technology, analogue and digital, we

developed to allow designers to be inside their shared representations, locally and at a distance. It is an intuitive immersive system that uses manual representations, freehand sketches and rough models, to exteriorize conceptual intentions.

To assess the CI process we have developed a methodological and theoretical framework presented here as three fundamentals of the design conversations: the CI Loops (Dorta et al. 2010), Collaborative Conversations (CCs) and Collaborative Movings (CMs). We have found that these types of design conversations, based on the known design actions of *naming*, *constraining*, *negotiating*, *decision making*, and *moving* (Goldschmidt 1990; Buccarelli 1988; Schön 1983), have recognizable forms and appear to follow a progression that matches the design project's progression. As a methodological framework, these *design conversations* capture this most sensitive as well as elusive dimension of the design process: the verbal and gestural conversation. In turn, as a process-based assessment tool bypassing the subjectivity of outcome-based evaluations, *design conversations* could provide better understanding of CI in the context of computer-mediated CI tools.

2. Collaborative Ideation (CI)

In order to exteriorize verbally and visually an idea (Goldschmidt 1990), designers need qualitative and ambiguous mental images and external visualizations in a continuous interaction (Visser 2006). Typically, designers see more in their sketches and physical models than what they put in when they made them (Schön 1983). They often work with incomplete information, assuming and taking provisional decisions that need to be revisited. Inaccuracy (flexibility), ambiguity (alternative meanings), and abstraction (simplification) are the main characteristics of this kind of reflective representations (Goel 1995).

Furthermore, designing is considered a social process (Buccarelli 1988). Teams locally and remotely discuss and negotiate between participants whose representations of the design are not aligned, and they do so by respecting the ambiguity while fostering a design conversation between the parties.

Verbal communication is considered to be the first design tool and the principal way of explaining ideas, even before visual representations (Jonson 2005). In a collaborative work setting, the designers communicate their ideas to others using verbal communication, gestures and physical and graphical representations. Verbalization on its own or in combination with other design tools drives ideation and is the most common means of externalizing design intentions (Jonson 2005). The strength of verbalization relies on words, in face-to-face settings or in computer-mediated environments (Lawson and Loke 1997). Words are more than just medium for communication: they are part of the thinking process. Creativity and information exchange are mediated by the social nature of design. And in turn, the collaborative and social aspects of design are supported by verbalization (Cross and Cross 1995). Linguists see the conversation found in CI as consensus building rhetoric, which is a specific kind of rhetoric where all parties strive toward a common resolution. This is very different from political debate for example, where the parties try to differentiate through their respective positions, or even from casual conversation where the dominant goal is to renew contact (Asher and Lascarides 2003). With CI we are in a

mode where participants build together through verbal conversation.

3. Assessing CI

Cognitive science and design theory have studied ideation, with controlled lab experiments mostly concerned with task execution, and through experiments using idea generation methods. There are two approaches in order to evaluate the effectiveness of CI: process-based that measures the process, and outcome-based relating to the results (Shah and Vargas-Hernandez 2003). For the first approach, data collection comes from protocol analysis. However, this approach is often unfortunately based on simple problems or tasks as opposed to real design issues (Shah and Vargas-Hernandez 2003). On the other hand, the outcome-based approach is questionable because it is based on the designer's performance. Evaluating the results of CI is hard because it depends on the designers practice and capabilities, which rely on subjectivity.

4. Design conversations

4.1 Collaborative Ideation Loop (CI loop)

In order to measure the collaborative design, Kvan and Geo (2004) have proposed the use of design framing, as stated by Minsky's four-level frames: synthetic and narrative as depicting frames and semantic and thematic as descriptive ones. However, aspects related to negotiation and moving during ideation are not considered. The CI Loop (Dorta et al. 2010) is a methodological compound instrument grounded in Bucciarelli's (1988) design as social process, Schön's (1983) reflective conversation and Goldschmidt's (1990) graphical representation of concepts and actions. The CI Loop is based on five main elements common in the analysis of the design conversation and design process among those three authors: *naming*, *constraining*, *negotiating*, *decision making* and *moving*, with sub-elements for each one and their relationship with gestures namely *pointing* and *gesturing*—our shorthand for drawing in the air (Dorta et al. 2010).

Designers will be *naming* the object of design or the specific element being discussed, *constraining* the project through its requirements and boundaries (time, budget and other constraints). They will be *negotiating* or articulating verbal meanings associated to visual images. This category is expanded to three subcategories: *proposing*, verbally making a design proposal, *explaining*, substantiating, and *questioning*, raising issues about or giving a rebuttal to a given proposal. They will be *making decisions*, specifically agreeing or disagreeing, on a proposal, thus marking the end of the negotiation. They will be *moving*, by adding to the representation and making pointing and sketching gestures. The first four actions are usually in the form of verbal exchange, while the *moving* is an act, which transforms the design situation (Goldschmidt 1990, Valkenbug and Dorst 1998).

We called this CI pattern a loop because it repeats itself, and it seems to spring from one to the next, often creating sequences of loops. Frequently, the participant

who sealed a loop with an agreement will initiate the next loop. To be considered a CI Loop, a collaborative exchange (1) has to involve two or more participants, (2) will usually start with a *naming* and (3) has to have a verbal exchange, so it will have at least one constraining, proposing or questioning before there a decision is made, (4) has to end with a decision making (agreeing or disagreeing), and (5) has to have at least one occurrence of *moving* or *proposing*, or both.

4.2 Collaborative Conversation (CC) and Collaborative Moving (CM)

Moreover, we also consider two other types of conversations linked to the ideation process: the Collaborative Conversation (CC) and Collaborative Moving (CM). CCs are indirectly involved in the ideation as either a discussion about concepts indirectly related to the design, or the presentation of a resolved design solution. CMs happen once the concept is secured. It is a bout of rapid ideation where a number of small decisions are being made on the sketch as it progresses. The verbal exchanges are few and short, *decision-making* agreement replaced by an immediate *moving* on proposals. It is often an exciting moment where both designers are involved—actively by drawing, or passively by following the progression, analysing the coming result and making punctual proposals as needed.

5. The interconnected HIS

Implemented in 2007 (Dorta) and assessed and compared as ideation and co-located collaboration tool (Dorta et al. 2009), the HIS permits freehand sketching and physical model making layered with in-context images, in immersion (life sized and real-time). It is a low-tech system: a tablet laptop (Axiotron Modbook™), a projector, an HD IP camera and a 360° immersive projection system based on spherical panoramas. The user sketches on the tablet or makes a rough scale model (in the model station) while spherical images are projected upwards to a semi-spherical mirror on the ceiling and then reflected on the ceiling-mounted semi-spherical 5m-diameter fabric screen. The user sketches in a normal perspective while the HIS software distorts the sketch in a spherical panorama. The tablet laptop is mounted on a rotating device that allows users to always sketch in front of them inside a drawing area while they look all around at a normal (undistorted) life sized 360° perspective on the screen, thanks to the *trompe l'oeil* effect (from inside, users feel inside a 3D environment). Based in the same optical distortion, the model station uses the IP camera combined with a tiny semi-spherical mirror to capture in real-time (low fps for better transfer rates) the rough scale model while projected at life-size on the semi-spherical screen (avoiding the *Gulliver effect*), (Figure 1).

The HIS can receive up to four people for co-located synchronic collaboration combining real and digital tools, interactions (acquired skills) and data. In order to address real practice requirement for remote collaboration, we networked two HIS. The sketch and the immersive real-time video of the model can be shared symmetrically (between two HIS). In this distributed setting, sketch data is relayed to a server that sends the information to the other HIS software while the video is accessed directly from the IP camera. Moreover, the drawing area tells who's online

(or presence), knowing continuously where the partner is looking and sketching. The two HIS were installed in two universities (UC Berkeley, School of Architecture and the School of Industrial Design at the Université de Montréal) (Figure 1). This setting engaged all remote collaboration issues, such as multidisciplinary, differences in time, language and culture. A commercial VoIP made verbal exchanges possible. See Dorta (2007) for the original HIS description.

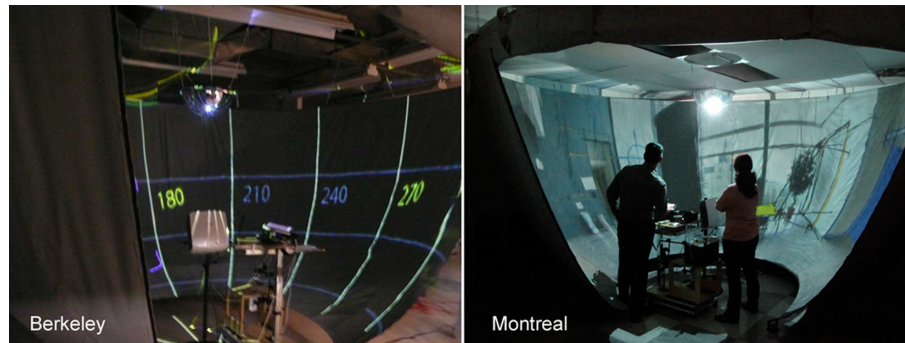


Figure 1. The interconnected HIS, here with part of the spherical screen open

6. Experiment

Two teams of two students, architecture (Berkeley - team a) and industrial design (Montreal - team b), participated in the ideation of a bus shelter as an ad-hoc project for about 6 hours over 3 days in the following sequence:

- On the first day, after an hour-long introduction and training, the 4 participants launched in a first synchronic ideation of 50 minutes.
- On the second day, making use of the time difference, before Berkeley woke up, Montreal had an local ideation session, working in the HIS with a rough physical model for 40 minutes (time spent making the model outside the HIS is not accounted here). Then the two Berkeley architects joined them for a remote work session (50 minutes) starting with the presentation of Montreal's three design proposals, interspersed with discussions about relevant supporting concepts (e.g. how snow behaves around a bus shelter), leading to some remote co-design. The Montreal team retired, leaving Berkeley to continue locally for an 80-minute session.
- The last day, both teams worked together at all times. First Berkeley presented their work (60 minutes), and then they co-designed a final concept (75 minutes). Total: roughly 6 hours.

The teams had to work in a suggested timeframe, which was adapted to make sure they came to a natural stop at the transition times. The CI Loop, CC, and CM were used to code all 6 hours of video recordings in 10-second increments, noting all actions occurring in each increment. If an action lasted longer than 10 seconds (for example, a particularly long explanation) it has been accounted for multiple times,

marking its importance in time.

7. Results

7.1 CI Loops

We have observed that there are 2 different types of CI Loops, (1 and 2), corresponding to the different lengths of loop observed in a previous study (Dorta et al. 2010). CI Loop 1 (Figure 2) focuses on securing larger design concepts (e.g. *let's do a green roof, the bus shelter should be made of modular sections*), which invites wider verbal exchange (more *negotiations* than *moving*). CI Loop 2 (Figure 2) focuses on giving form to the previously agreed general concepts and is involved with specific issues that can be resolved in and by the representation (e.g. *should the angle of the roof be that strong? Let's make the structure a little bigger*). These exchange are usually shorter, having less *negotiations* and more *moving*, since they are confined to a specific issue at hand in the representation. We have also observed that CI Loops (1 and 2) will often come in a sequence as the object of the conversation evolves from being unresolved in the first loops to resolved in the last, giving what we have termed immature to mature loops. The degree of maturity of a concept does not affect the structure of the CI loop, other than the mature loops may be sealed by vocal agreements from all participants.

We have observed that the basic CI Loops structure takes different forms. A CI loop will usually start with a *naming* unless the object of discussion is implied (using a pronoun) or carried over from the preceding CI Loop, or if, instead of *naming* it, the participant *points* to it, substituting a *naming* for a *pointing*. *Naming* and *pointing* gestures are often paired that way. In a CI Loop, there will be an exchange, meaning at least one (but usually more than one) *constraining*, *proposing*, *explaining* or *questioning* to which the other participant will respond to by agreeing or disagreeing (a *decision making* action). Although *decision making* is a crucial category to the articulation of the CI Loop, it is often the shortest verbal communication, from a nod or a barely audible *yeah*, to a clear articulation of approval. Not all nods and *yeahs* are *decision-making* actions though; the purpose of some is to nudge the speakers forward in their explanations. A *decision-making* action is a punctuation that seals the exchange with a (dis)agreement. *Moving* actions have a particular relationship to the CI Loop; they are non verbal, they often come up in conjunction to a verbal proposal, and sometimes they will act as a *de facto* agreement in CI Loops, replacing the *decision-making* action (for instance, when a suggestion is silently responded to by an adjustment in the sketch). The final condition defining a CI Loop is that there has to be a *moving* or a *proposing*, both being the only two actions directly manipulating the design with words or through representation. If any of these five requirements are missing, it may be a design related conversation, but it is not a CI Loop.

Of all the design conversations, the CI Loops have the most recognisable pattern, with its musical scale structure going from *naming* to *negotiations* and finishing on *decision making* and *moving*, and back up again on the next loop. In this case study, we were also given an opportunity to recognise the shorter CI Loop 2 by

sound: two of the participants were Spanish speakers, and a few times they slipped into Spanish for quick conversations. Some of our research assistants not familiar with Spanish realised that in spite of not understanding the content of the conversation, they could recognise the form of the CI Loop 2 through its prosody (i.e. rhythm and intonation), which goes from high-pitch *naming/questioning* or *proposing* to a quick *negotiation* to a low-pitch *agreement*. The oral dimension of design conversations would be an interesting research to pursue, particularly for distant, multicultural CI.

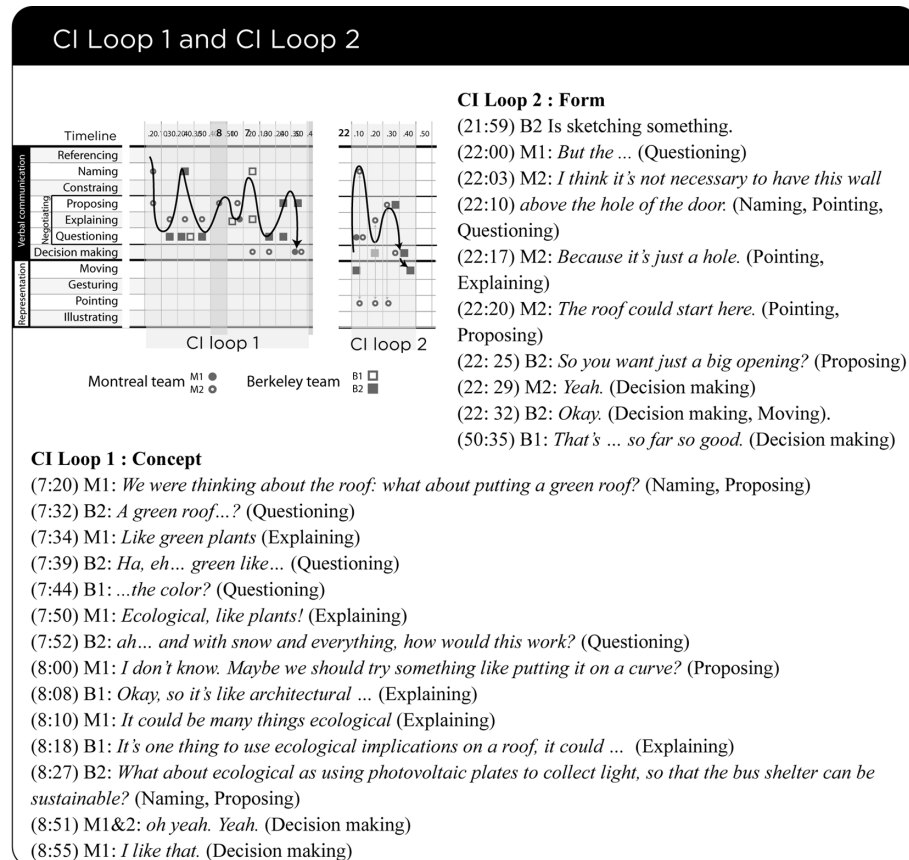


Figure 2. Examples of CI Loops (1 for concepts and 2 for the form), with their dialogue

7.2 Collaborative Conversations (CC)

If only four out of five requirements of a CI Loop are met, the exchange was a CC indirectly involved in the ideation. CCs have a predictable pattern (Figure 3), but are neither a loop (no springing in the argumentation from one pattern to the next), nor do they directly move the design forward. They are either *presentations* of

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previously agreed design, or *discussions* about concepts indirectly related to the design. They are an unavoidable part of the CI. The two CCs patterns share one key characteristic: they have no *moving* actions. *Presentations* are not dialogues, in the sense that there is no negotiation; they have a lot of *proposing*, as speakers present and explain their proposals, with the listeners stating their agreement punctually after each *naming*, *proposing* and possibly *explaining* sequence. Questioning, if it is to demand clarifications, is part of the CC; but if it questions the presented concept, will lead to a CI Loop. *Discussion* about indirectly related topics are dialogues and have much back and forth between *explaining* and *questioning* but significantly no *proposing* (or *moving*).

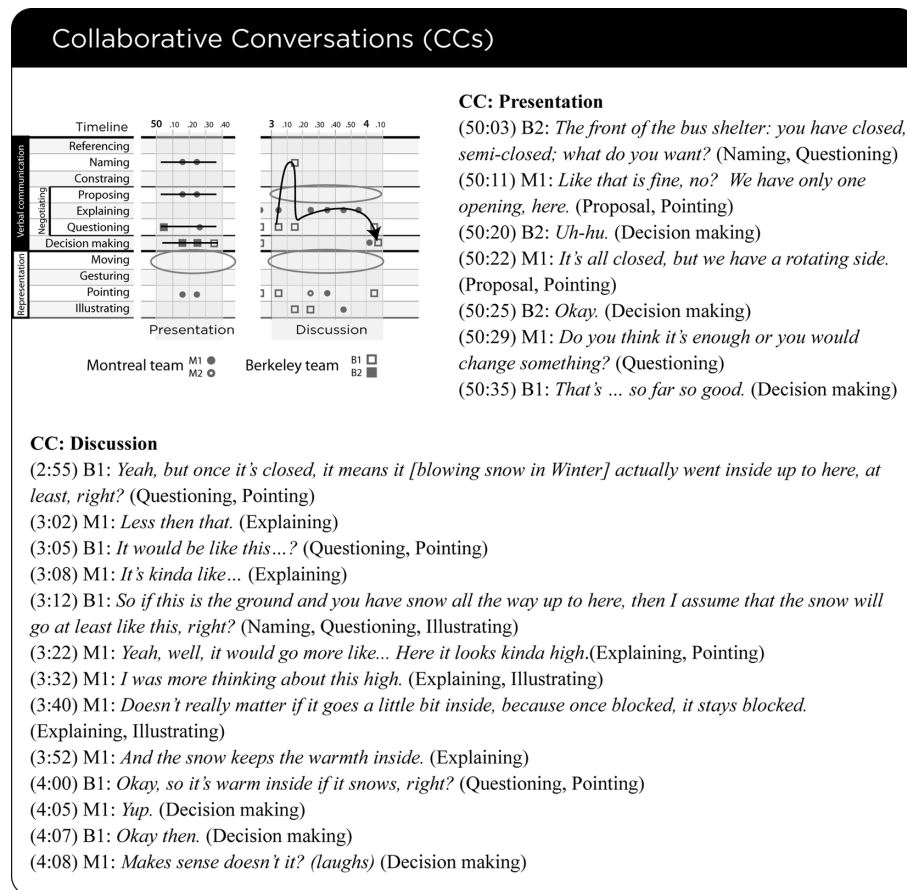


Figure 3. Examples of Collaborative Conversations (Presentation and Discussion), with their dialogue

7.3 Collaborative Moving (CM)

We have observed CM to occur once the concept has been broadly identified, usually following CI Loops 2. It has a “heartbeat” pattern: a horizontal sequence of continuous *moving* interrupted by a quick—vertical—conversation (see Figure 4). This kind of conversation accompanies the last stage of ideation before switching to another kind of design tool, which is different from illustrating a concept to better communicate it to a third party; CM occurs while still giving form to a concept for the first time. It is an active moment where a lot of specific design decisions are made and worked out in the representation as it develops. There are mostly *moving* actions with some *questioning*, *proposing* or *negotiating*. *Naming* is often replaced by *pointing*, *decision making* by *moving*. CM is the least verbal collaboration where most of the design conversation is done *through* the representation. As its name states, CM is collaborative. In the HIS, the participants who didn’t control the pen, still had full access to the shared immersive representation, therefore they could follow the development of the design and participate by reflecting on it and analysing it in a way that the drawing-participants could not. On its own, an individual reflective conversation with the representation does not constitute a CM.

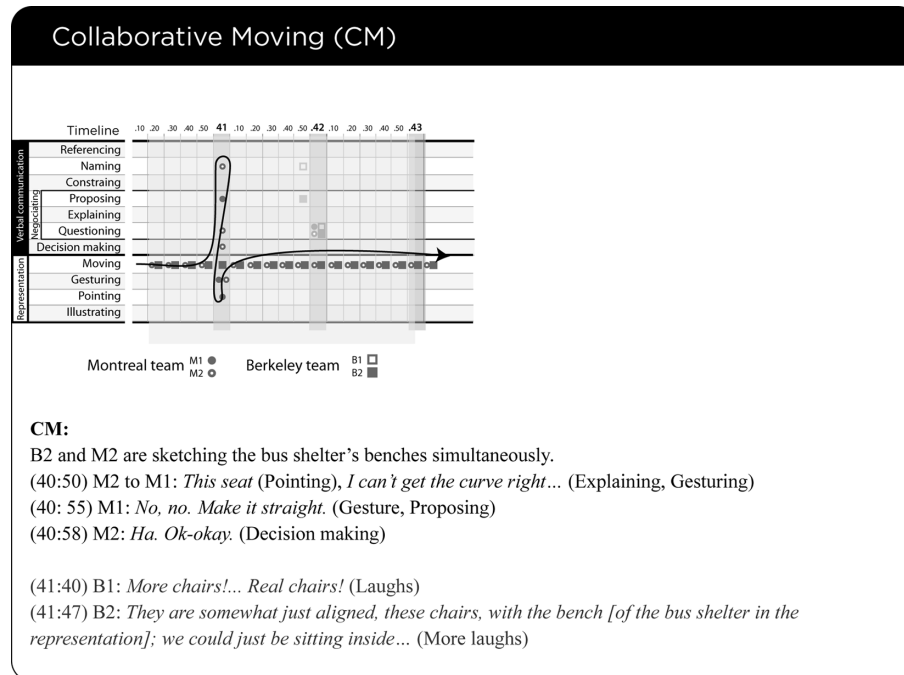


Figure 4. Example of Collaborative Moving, with its dialogue

7.4 Timeline of design conversations

The interconnected HIS has clearly supported collaborative ideation throughout the

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6 hours of the protocol, as shown by the design conversations recorded from the very beginning until the end of the protocol (see Figure 5). The timeline shows the different design conversations evolving from one another to form three cycles of ideation over the 6 hours. In the first cycle, the design conversations went from mostly CI Loops 1 to CI Loops 2, with only a few instances of CCs/discussion; no CMs. The second cycle started on a large number of CCs/presentations then moved through CI Loops 1 & 2 as well as some CMs. The last cycle had a progression of CCs—presentation and discussions—CI Loops 1 and 2, and the most CMs. As the project progressed from one cycle to the next, the amount of CMs got increasingly larger, which may be a sign that a resolution was reached.

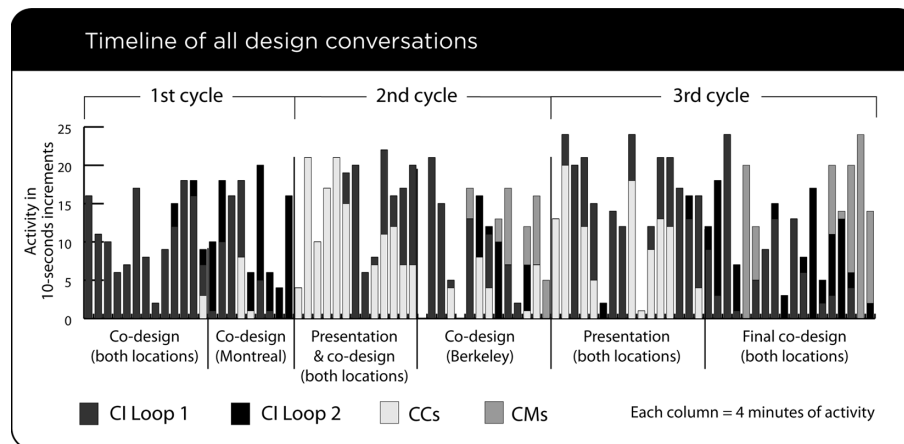


Figure 5: Timeline of all design conversations

8. Conclusion

As fundamentals of the design conversation, the recognisable patterns of CI Loops, CCs and CMs should make it easier to harness and evaluate design conversation in CI, a key element that leaves no trace of itself, driving and shaping the CI process as it slips through it, like water through fingers. They are the basis of a methodological framework with which to understand CI activities, and as such they point to needs that should be supported by CI tools. In this study, the CI tool used, the HIS, was apparently able to support all stages of the CI process: the qualitative and ambiguous visual representations driven by verbalisations at the beginning (where there is more talking than moving in CI Loop 1) and the levelling of verbalisation and moving actions (CI Loop 2). Then, when the concept was broadly identified, the HIS kept supporting the shaping of a specific form as *moving* actions drove the CI process forward (CMs). In the HIS, CMs were truly collaborative because the shared immersive representation allowed a shared reflective conversation by all participants simultaneously. Collaboration at this stage should not be overlooked in spite of the conversation being less verbal. This study brought to the fore that a CI tool has to

offer well integrated attributes that can evenly support two or more people in verbally driven (at first) and representation-driven (shortly after) CI while supporting their simultaneous reflective conversations throughout this process.

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