Collaboration Support
in the Initial Intercultural Collaboration Phase

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ABSTRACT
Collaboration of participatory design is often carried out by a wide variety of members from several work cultures especially in the initial design stage. However, little is known about how to support work culture difference. This paper presents an analysis of participatory design case applied to software development collaboration project. The analysis is from an intercultural point of view and aims at finding ways to support intercultural collaboration activities. Investigation how intercultural communication errors are recognized, repaired and bring agreements to participants were made. Surprisingly, our analysis indicates that the initial stage of a participatory design process mainly relies on a dynamic and creative process where participants create expressions together with unique semantics rather than just transferring static terms from each others own vocabulary.

Author Keywords
Collaboration Support, Intercultural Collaboration, Design

ACM Classification Keywords
H5.3. Group and Organization Interfaces: *Collaborative computing, Computer-supported cooperative work*

H1.2 User/Machine Systems: *Human factors*, *Human information processing*

1. INTRODUCTION
There are several design support techniques that apply to participatory design such as personas, prototyping, video card games [1], and design games [2]. All of them aim at mediating and facilitating collaborative work among participants such as developers, interaction designers and uses. However, in current participatory design approaches and their supplemental design support techniques, other aspects of participatory design such as cultural, social and political issues are often neglected [10].

In practice, collaboration activities in a participatory design process are often carried out by a wide variety of members from several work cultures. Wenger [13] calls a cluster of people sharing the work culture *communities of practice.* Participants in collaborative work bring together several communities of practice with collective concerns. Fischer [4] defines these as *communities of interests*. When people form communities of interests, they tend to have different preferences [10], culture, sense of values and terminology [3]. Thus in collaborative work, it is believed people from different work cultures need to understand each others' cultures through sharing information and knowledge [5].

This paper investigates a collaborative activity in a software development project. Investigation aims at finding ways to support participatory design activities from an intercultural collaboration point of view. We analyze data focusing how collaborative communication process is carried out.

We expected to see a transferring process of terms with static semantics brought by each participant to the project team. Contrary to our expectations, participants seem to reach agreement via a creative negotiation process where new terms with unique semantics fitting to the task at hand are developed. Our results indicate that it may be more effective to promote creativity in the initial stage of participatory design rather than supporting understanding on others to facilitate intercultural collaboration.

The paper is organized as follows. First we introduce the theoretical background of our approach to intercultural collaboration support. Next in section three, characteristics and its analysis of our participatory design case, software development collaboration, are explained. In section four, based on the analysis, we propose that the intercultural collaboration process on participatory design can be supported as creative design process rather than shared understanding process. Finally in section five, we conclude and discuss directions for future work.

2. INTERCULTURAL COMMUNITY COLLABORATION
It has been discussed that in collaboration among people from different work cultures, people need intercultural communication through sharing information and knowledge. Intercultural communication means more than

just translating language of one culture to language of the other at a symbol level [8] because it is often the case that different work cultures have different semantics for identical symbols and representations. This ontology drift often occurs unconsciously in intercultural collaboration [9]. People realize the ontology drift when a break down [11] in communication occurs. Thus, to overcome different perspectives and different vocabularies [4] is thought to be the initial challenges of intercultural collaboration.

In collaborative activities among intercultural community members, external representations often play an important role as a boundary object [12]. Community members gradually build ability to collaborate when each member can associate a word and an object to his/her own representation world [8]. External representations working as boundary objects can be used as media either for *sharing* or *learning* at one time, or for *creating* or *negotiating* meanings [13] at another time.

In participatory design, participants bring together different communities with different work cultures and interests. Thus, it is beneficial to approach participatory design from an intercultural collaboration point of view in order to address social and cultural issues.

3. CASE STUDY
In this section, we analyze a participatory design case. The overall objective of the analysis is to find ways to support collaborative work of participatory design. We focus on the process how intercultural communication errors are recognized, repaired and bring agreement to participants through external representations that function as boundary objects. Through analysis, it is expected to answer about what kind of external representations can be boundary objects, how agreement are made through those key external representations, and what kind of reasons accelerate or prevent from reaching agreements.

3.1. Observation Experiments
The case is a software development project where four participants collaborate. Their objective is to design a tool for protocol analysis for academic researchers. An ethno-graphical approach was taken for investigation.

The four participants are one client, two programmers and one interaction designer. Three kinds of data, video taping, voice and photos, were collected during a span of four days. The total length of the discussions was twelve hours. Five photos were taken for recording drawings on a white board. Protocol was transcribed from video and voice data.

1st meeting: A client explained protocol analysis process to programmers and an interaction designer. The client used a projector to show real protocol data while explaining.

2nd meeting: Based on the first meeting, the interaction designer asked questions, the client suggested desirable functions of a future analysis system and the programmers often interrupted conversation in order to show their initial ideas for functions and approaches. Projectors and personal computer screens were used to show ideas.

3rd and 4th meeting: Third and fourth meetings were held in a row in a day. The programmers showed the initial system functions and mockups. To explain functions projectors and their personal computers were used. The client asked for more functions, specified requirements in details, and confirmed suggested functions.

3.2. Approach
External representations were identified in conversation protocols as key expressions.

First, the transcribed 12 hours of conversation was analyzed with the morphological parser for the Japanese language, *ChaSen*[1] that categorize each morpheme. The results of Chasen were filtered into nouns, verbs and adjectives. After that, the frequency of each word was calculated both for the total conversation and for each participant. We defined the top 30 words and expressions to be key expressions (ex. *Label, Concept, Coding Scheme*).

Next, the transition of the number of usages of each key expression was analyzed and visualized with colors based on functions of Popout Prism[2]. Figure 1 shows a transition of key expression *Label* in relation with other key expression. Co-occurrence relations among key expressions over time were also calculated and visualized with Polaris [7] that reads morphological data and visualizes key word relations in a graph structure based on the co-occurrence calculation results.

The objective of this analysis is not to define and generalize key expressions, but to understand how people discuss, negotiate and agree by investigating usages of key expressions. As a first step of our analysis, conversation protocols are investigated among a wide variety of external representations. Other kinds of multimodal representations such as figures drawn on the white boards, distributed documents, and repeatedly used body language are also key external representations and will be targets for analysis.

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[1] http://chasen.naist.jp/hiki/ChaSen/

[2] http://www2.parc.com/csl/projects/popoutprism/

Figure 1. Relations between *Label* and other key expressions in Popout Prism

3.3. Analysis Results

In this section, three kinds of findings observed in visualization results around key expressions are explained.

Negotiation of Meaning

Frequently used expressions throughout all meetings, for example *Label* has been used by all members since the first meeting. For example in the first 1.5 hours of the fist meeting *Label* was used 44 times while in the last 1.5 hours of the fourth meeting, the expression was used 39 times. Co-occurrence graphs of each member shows that co-occurrence relations between *Label* and other key expressions differed drastically from person to person in the first meeting. However, over time each member's co-occurrence graph came to have much similarity. Figure 2 shows how the co-occurrence graphs for *Label* for two participants (programmer A and the client) become similar over time.

Protocol analysis [14] shows that members seem to have exchanged questions and answers as for *Label* repeatedly. Negotiation of meanings through confirmations in relation with another key expression are the most frequent.
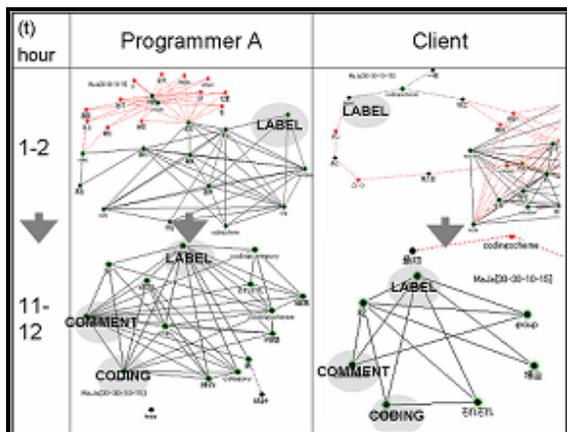
Figure 2. Co-occurrence graphs for *Label* for two participants

Creation of Expressions

Key expressions, for example *Segment Table* has been used frequently from the second meeting. The protocol analysis shows that the key expression, *Segment Table* was coined in the beginning of second phase through the negotiation process shown in the following conversation. The expression, *Segment Table* was used by all participants since this moment.

> Programmer A : This name.., how about grouping table?
> Client   : Well….
> Programmer A : How about coding category table?
> Client   : It is odd. We call it segments.
> Programmer B : Ok, let's call it a segment table.

Convergence of Expression Usages

The key expressions *Tree* and *Ki* (means a tree in Japanese) were used frequently in the beginning of meetings. However, the usage of *Ki* decreased over time. For example, in the first meeting, programmer A and the interaction designer use an expression, *Ki*, while programmer B and the client used the term *Tree* as tree structure in their conversation. On the other hand, in the last meeting, all participants used the expression *Tree* when they meant tree structures.

> *-In the first half of the first meeting-*
> Programmer A : This *Ki* is
> Client   : When I think this as *Tree* structure
> I. Designer   : No, you mean the leaf of the *Ki*-structure
> *-In the second half of third meeting-*
> Client   : Which part of the *tree*?
> Programmer A : Bottom part of the *tree*…

4. DISCUSSION

From the analysis of the intercultural collaboration process through key expressions, three kinds of collaborative processes leading to agreement were identified.

1. Negotiation of Meaning
2. Creation of Expressions
3. Convergence of Expression Usages

In negotiation of meaning, participants discuss meanings of key expressions to define exact meanings among participants. The meanings often become unique to the participants and could often be different from conventional dictionary definitions. Observing and analyzing both the co-occurrence graphs and conversation protocol, it became clear that a definition of key expressions (*Label* in the example) is gradually fixed through iterative interactions among participants. Every four member's co-occurrence graph changed its semantic distance over time and became similar in the end. Thus, in this collaboration process, exact definitions of key expressions often don't exist in the beginning and they are created by negotiation.

In creation of expressions, participants collaboratively coined names to new concepts during the discussion through negotiations. The co-occurrence graphs clearly show the moment when new expressions were coined. The

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communication protocol often shows a similar creation process of new expressions. Before participants started to use newly created expressions, they often discussed ideas or concepts that will lead to new expressions afterwards.

In convergence of expressions, when participants have different expressions that indicate the same concept, the shared concept often converges to one expression through negotiations. Cross reference of co-occurrence graphs and communication protocol shows that when the number of usages of one expression increases drastically, it is sometimes caused by convergence of expressions.

The findings shown in this paper indicates that new meanings or new expressions are added to key expressions or created in intercultural collaboration over time. In other words, in our intercultural collaboration case, creations of expressions or concepts are quite usual. The initial process of intercultural collaboration might highly rely on this creative process among members.

These analysis results suggest investigating whether techniques for initial creative design support could also facilitate the initial stage of intercultural collaboration. For example, game approaches [1, 2] may be applied to intercultural collaboration support. Although the game approaches have their own aims, the overall purpose, support collaboration across various interests, is the same.

The idea of using creative support for initial collaboration support is also attractive for another reason. There are many similarities between the target group of creative design and intercultural collaboration communities such as temporary ("people come together in the context of a specific project and dissolve after the project" [4]), lack of shared understanding and potentially creative. All the more, while it is still not clear how and why important it is to support shared understanding, creative support provides unique opportunities for collaboration. So long as intercultural collaboration is in the initial stage, creative support has high potential to facilitate intercultural collaboration for collaboration sake.

5. CONCLUSION
In this paper, we have analyzed a participatory design process in the form of software specification meetings. We have aimed at finding ways to support intercultural collaboration by analyzing communication protocols of the collaboration process. Our analysis indicates that the initial phase of intercultural collaboration relies on a creation of new expressions rather than just transmitting each others' understandings. We concluded that creativity support have high possibility to become an effective approach for the initial stage of intercultural collaboration.

Further investigation is needed in order to apply creative design approaches to collaboration support. In particular it should be examined whether the creative design techniques in participatory design can be applied to intercultural collaboration support.

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