A cross-cultural study of co-design: The impact of power distance on group dynamics in Japan

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This study explores the characteristics of collaboration between people with Japanese value orientation in co-design workshops. We define co-design as an approach where designers collaborate with non-designers to design new products or services. This research investigates the effect of culture and value orientation on co-design between designers and non-designers in a Japanese context. Through interviews with four professional designers, we identified that the participation of Japanese non-designers in a co-design workshop might be hindered by the presence of an expert, who is perceived as a person in a higher social position. With 20 subjects, we experimentally investigated the impact of power distance on collaboration. European and Japanese groups of non-designers generated and discussed ideas in two conditions—with or without a professional designer in the group. Through behaviour and speech analysis, we assessed the quality of collaboration within the group. Depending on their power distance score, the contributions of participants were affected differently by the presence of a professional designer. Unlike in the European groups, the presence of a designer in a Japanese group created a hierarchical structure that hindered the participation of non-designers. This work is expected to support the development of co-design methods adapted to their cultural contexts.

Keywords: Co-design; cultural dimensions; value orientation; power distance; design collaboration; East Asia.

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Introduction

Co-design can be defined as an approach where the general population and designers collaborate to imagine and design new experiences, products or services (Sanders and Stappers 2008; Manzini 2015). Co-design, as it emerged in the area of participatory design, historically assumes an equal and open discussion between participants, irrespective of their social status or professional background (Ehn and Morten 1991), and thus mainly developed in Western countries in Europe and North America where the local population shares similar value orientation regarding social relations.

Other studies have examined the behaviour of participants across several countries in collaborative design activities, e.g. focus group (Lee and Lee 2009), context-mapping (van Rijn et al. 2006), creative games (Yasuoka, Nakatani and Ohno 2013) and brainstorming (Détienne et al. 2016). Although these studies have not looked at co-design, their findings suggest that collaborative design activities might be affected by the sociocultural context in which they take place and by the value orientation of their participants.

In this paper, our objective is to understand co-design collaboration in the specific context of Japanese culture, compared to the Western context. We examine the influence of the value orientation of participants on the quality of their collaboration and the group dynamics in co-design. The first section of the paper is a review of studies that explore the link between cultural characteristics of participants and collaborative design activities. In the second section, we report the outcomes of an interview with four Japan-based designers about their perception of Western and Japanese people's behaviour in co-design workshops (Study 1). The interviews suggested that Japanese non-designers tend to refrain from actively participating in co-design discussions when there is an authority figure in the group. To explore this issue further, we experimentally

investigated the link between power distance, i.e. the extent to which the less powerful members in a group expect that power is distributed unequally, and collaboration in a co-design workshop with twenty subjects from Europe and Japan (Study 2). To the extent of our knowledge, this investigation is the first attempt to examine cross-cultural differences in co-design activities, in a Japanese context.

Literature review: Co-design and cultural orientation

Co-design, a collaborative design activity involving designers and non-designers

Design practice has been involving end-users in the design process of new products or services through a participatory design approach. Participatory design has its roots in Scandinavia in the 1970s. Early participatory design practice was formed through design projects aiming to incorporate worker opinions for improvement of their workspaces (van der Velden and Mörtberg 2014). Therefore, a participatory design approach emphasised the participation of non-designers to realise social and rational ideas of democracy and to know participants' 'tacit-knowledge' (Simonsen and Robertson 2012). To address the tacit-knowledge of participants, designated tools and techniques are employed in participatory design projects. Participants in participatory design investigate together what needs to be achieved and are expected to state their opinions freely (Sanders 2002). Co-design appeared as a sub-branch of participatory design (Sanders and Stappers 2008) and can be defined as *the process in which actors from different disciplines share their knowledge about both design process and the design content. They do that in order to create a shared understanding on both aspects, to be able to integrate and explore their knowledge and to achieve the larger common objective: the new product to be designed'* (Kleinsmann and Valkenburg 2008). Designers become facilitators using the collective creativity of participants.

In this paper, we define co-design as a design approach where people without design skills (e.g. citizens/users) actively collaborate with people with design skills (e.g. designers) to generate new ideas of products or services.

Culture and value orientation

Culture is a broad and complex concept that can be defined as a set of norms and value orientation shared by a group of people, or '*the collective programming of the mind that distinguishes the members of one group or category of people from others*' where categories can be countries, regions, gender or age groups or organisations (Hofstede, Hofstede, and Minkov 2010). In this paper, we specifically look at the national culture described through six criteria: power distance, individualism, uncertainty avoidance, masculinity, long-term orientation, and indulgence (Hofstede, 2001). Another definition of culture, the value orientation theory, proposed that it is possible to distinguish cultures based on how they address five common human concerns: social relations, human nature, man-nature relationship, time sense and activity (Kluckhohn & Strodtbeck, 1961).

When studying culture in co-design activities, we specifically look at the culture of individuals as members of a group, and we investigate how culture and value orientation influence individual behaviour within the group and related social processes. Both definitions of culture include a dimension that is strongly related to social processes: social relations (Kluckhohn & Strodtbeck, 1961) and power distance (Hofstede, 2001). Cultural norms related to social relations define what the best form of social organisation is, either hierarchical, collateral or individual, in a given cultural space. Similarly, power distance (Hofstede, 2001) is defined as the extent to which people in a lower social position expect and accept that power is distributed. The power distance index, 54/100 in Japan vs 28/100 in the Nordic countries where co-design

originated, show that Japanese society is more hierarchically organised than in Nordic countries where people believe in decentralised power and equal rights (Hofstede, 2010). Their communication style is participative and direct regardless of social hierarchy. In contrast, in Japan, people accept unequally distributed power as an integral part of society. Superiors are expected to look after subordinates, which, in turn, show loyalty towards the former. This belief entails the subordinates to refrain from expressing their opinions freely, especially negative thoughts, such as disagreement.

Although sub-cultures can be found in a national group, some core values are significantly shared by most of its members, as shown in the studies by Hall (1976) and Hofstede (2001) and design, as a social activity, might be impacted by the national culture/value orientation. Co-design workshops, where people in various hierarchical positions, with a different level of design skills, are asked to collaborate, might be impacted by the power distance score of the participants.

Cultural differences in design activities

Early cross-cultural studies of design focused on the effect of value orientation on the design outcomes. For example, Leong and Clark (2003) attempted to develop a new Hong-Kong subjectivity in design through an East-West comparative cognition approach where they looked at the behaviour and social interactions affected by using artifacts, both in the East (mainland China, Hong-Kong) and in the West (UK, Netherlands). They identified specific cultural traits in traditional Chinese culture and in contemporary Western culture, in relation with the use of designed artifacts.

Recent cross-cultural studies of design address not only the links between culture and designed artifacts, but also the links between culture and design activity, i.e. individual and group behaviours, and social interactions, through questionnaires, interviews, assessment of the design outcomes or behavioural analyses (cf. Table 1).

Van Boeijen (2014, 2015) examined the influence of culture on design process regarding design methods in several countries. Van Rijn et al. (2006) investigated the application of context-mapping techniques in South Korea, in comparison with the Netherlands. Tran and Lee (2009) explored the differences between South Korea and Vietnam in a generative session. Lee and Lee (2009) compared focus group discussions in the Netherlands and South Korea. Yasuoka et al. (2012) investigated the impact of a design game in co-design with Japanese and Danish groups.

Study reference	*Observed design task*	*Profile of the participants*	*Nationality of the participants*	*Analysis*[1]				*Main findings*
				I	*Q*	*O*	*B*	
van Boeijen, 2015	Student design projects[2]	Students (industrial design)	(various)	X	X			- Six types of barriers: trust, credibility, language, values, attitude and education, for participatory design in a cross-cultural context
Hall et al., 2004	Plus-minus method and think aloud	Students (PhD in technical sciences)	The Netherlands & Asia and Africa[3]			X	X	- Plus/Minus method did not work with Asian and African participants. - Think aloud method works in both countries - Asian/African participants follow task instructions more than Dutch
van Rijn et al., 2006	Context-mapping	Students	The Netherlands & South Korea				X	- Three factors; trust, control, nunchi for context-mapping in East Asia - Seven tips for conducting context mapping in East Asia
Tran & Lee, 2009	Generative session (collage, mapping)	Students (design and engineering)	South Korea & Vietnam		X	X	X	- More sensitising required for Vietnamese - Both participants needed to be encouraged
Lee & Lee, 2009	Focus group discussion	Students (industrial design)	The Netherlands & South Korea		X		X	- More verbal utterances from Dutch participants - More pivotal role of facilitator in the South Korean group
Yasuoka et al., 2013	Design game	Company employees (end-user, engineer, marketer, designer)	Denmark & Japan		X	X	X	- Japanese described the same data positively, Danes negatively - Japanese more strictly follow the design game rules than Danes - Japanese sought implicit approval before talking, Danes ignored and interrupted others' speech
Détienne et al., 2017	Brainstorming	Students (engineering)	France & Japan		X		X	- A similar culture of collaboration concerning the engineering domain - Different appraisal of dimensions of group work (e.g. argumentation)

1. I: Interview, Q: Questionnaire during/post design activities, O: Assessment of design outcomes, B: Behavioural analysis
2. Five projects aimed at designing for people from different cultural backgrounds.
3. Asia: India, Indonesia, China, Turkey and Africa: Sudan

Table 1 Related studies investigating cultural differences in design activities

From these studies, we could identify six issues related to design activities in an East Asian context, i.e. Japan and South Korea.

(1) Sharing ideas freely with people in a higher hierarchical position. East-Asian people are less comfortable expressing opinions with people in a higher hierarchical position openly or with people perceived as such. In workshops with people in different hierarchical positions, people in higher positions tend to be the only ones who dare to talk (Yasuoka, Nakatani, and Ohno 2013; van Rijn et al. 2006; Lee and Lee 2009).

(2) Collaborating with strangers. People are reluctant to share their honest opinions with strangers in workshops. People need time to immerse themselves in the context of workshops and to be comfortable in front of strangers (van Boeijen, 2015).

(3) Trusting the facilitator. The participants do not share their opinion unless they feel respected and are convinced of the usefulness of their participation. They also need to trust the facilitators intention of how their participation will be used (Lee and Lee 2009; van Boeijen 2015).

(4) Keeping the harmony of the group. East-Asian people hardly disagree with the implicit conclusion of group discussion, which leads to less diversified discussion. Conversely, it is also reported that Japanese participants tend to listen to each other more, and every participant gets a chance to speak out (Lee and Lee 2009; Yasuoka et al., 2013; Hall et al., 2004).

(5) Avoiding ambiguous assignment. Announcing a detailed plan for the session is recommended, and the facilitator should clearly explain what is expected in the session.

Conversely, East-Asian people seem to stick to the design assignment more rigorously (van Rijn et al. 2006; van Boeijen 2015; Hall et al., 2004; Tran and Lee 2009).

(6) Creating a 'common language'. The facilitator should speak the participant's language. However, speaking the same language is not the only important issue. Participants who are not comfortable with sketching sometimes feel ashamed. The confidence of 'language' in the design process is an essential factor in ensuring participants contribute (van Boeijen 2015).

Research Scope

Previous studies have shown that cultural characteristics influence the way people behave in design activities, but no study has specifically examined co-design activities defined as the creative collaboration between designers and non-designers. In this study, we aim to examine the link between culture/value orientation and the behaviour of participants in co-design activities in a Japanese context. To investigate this topic further, we interviewed four Japan-based designers about their perception of the behaviour of Japanese and Western people in co-design workshops (Study 1). Then we examined the behaviour of Japanese and Western participants during a co-design workshop (Study 2). The methodological approach, based mainly on the quality of collaboration method (Détienne et al., 2008), has been enriched by the application of the reactive token theory (Clancy et al., 1996). This original combined approach highlights cultural differences in designing activities.

STUDY 1: Perception of co-design workshops in a Japanese cultural context

Objective and method

Our objective was to identify the main characteristics of the behaviour of Japanese people in co-design workshops, as perceived by the facilitators of the workshops. We interviewed four designers—two Japanese, one Spanish and one French, from the Tokyo office of a global design firm. They all had a few years' experience in facilitating co-design workshops with non-designers, both in Japan and in Western countries (Spain, France, the United Kingdom, and the USA), as shown in Table 2. In this section, 'Western' represents the four countries. The interviewees have practiced co-design workshops with adult participants in companies and university settings. Their comments come from their experiences in various workshops rather than from one specific workshop.

Interviewee	*Nationality*	*Experience (years)*	*Countries of practice*
E1	Spanish	15	Spain, China, Japan
E2	French	5	France, United Kingdom, Japan
J1	Japanese	5	USA, Japan
J2	Japanese	2	USA, India, Taiwan, Japan

Table 2 Profiles of the interviewees

Each interview was conducted with one participant at a time and took about 60 minutes. It consisted of a semi-structured interview about the experience of facilitating co-design workshops with Japanese and non-Japanese.

Outcomes

In this section, we report the significant results found in the questionnaire, and quotes from the interviews. J1, J2 and E1 indicate that J2 and E1 also expressed J1's opinion in other terms.

More efforts to get people ready for idea generation

As shown by the questionnaire results, Japanese participants seem to have a less verbal expression before others, as compared to Western participants. Also, the dynamics of discussion seem to be fragile. As one Japanese interviewee mentioned:

> *You need to let them start. Start driving. Even though it is really out of the scope 'it is ok'. Let them start. If you say 'it is not a challenge', that kind of correction stops Japanese speaking up. If they stop, the conversation is dead. It never comes up.* [J1]

In idea generation activities, this leads to participants proposing a few ideas and building on another's idea. The interviewees reported their analysis of the underlining causes. One non-Japanese interviewee reported that:

> *There is less conversation in Japan, people accept anything coming out. They don't listen carefully; they are on different tracks. In Spain, there are questions and comments. In Japan, they still think about their ideas (when someone else speaks out). [E1]*

Both Japanese interviewees identified the Japanese education system as a cause.

> *In Japanese education, students are asked to study subjects with pen and papers rather than sharing their opinion with a classroom.* [J1; J2]

They deal with the barrier's byways of facilitation. Two Japanese interviewees mentioned that they give examples of ideas, including crazy ideas, in idea generation workshops. By doing so, participants feel free to speak.

> *In Japan, for Japanese and non-designers, you need to give an example to set the scope of crazy ideas. The designer needs to give a crazy example to broaden their scope, how high they can dream. [J1; J2]*

They also reported that they join group discussions while facilitating all workshops.

> *In Japan the facilitator needs to be more active, keeping the conversation alive and pushing the participants to be active.* [J1; J2]

Pros and Cons of a hierarchy in a group and dealing with the cons

A Japanese interviewee [J1] reported that are numerous types of hierarchies; hierarchy within a department, e.g. between superior and subordinate, and hierarchy among departments, e.g. sales and engineering. One extreme case in an ideation session with a client company was reported.

> *There was a woman [...] She was driving them most. She was really putting a lot of energy. [After CEO of the company joined the table] One minute, he sits on the table, she rarely, rarely did that. I did not see her move a finger in 30 minutes.* [E2]

Generally speaking, people in a lower position tend to keep silent during discussions, and people in higher positions dominate discussions about whether they want to or not. Consequently, the interviewees commented on not expecting equal participation from participants in workshops with Japanese.

> *In Japan, people don't like to admit they don't know something. Asking everyone to contribute might make them feel uncomfortable. We try but we don't push them, it could lead to a weird environment.* [E1]

The presence of designers can also cause the hierarchy. Designers seem to be cared for and respected by participants in design workshops. In other words, facilitators in workshops do not have to be strong, as people follow facilitation [E2]. However, it could also have a negative influence on the workshops. A non-Japanese designer mentioned his thought in comparison with his experience in France.

> *In Japan, title, especially designers title, is going to make people look at you like you know more than them about design. [...] In Japan, you are the expert, so I am going to shut up.* [E2]

The participants might follow designers blindly and become less active by creating a

hierarchy in the group.

Although all interviewees reported barriers to having a hierarchy in design activates, an interviewee sees the barrier is not a significant problem because they think it is possible to handle. The interviewee mentioned a background philosophy:

> *To speak an opinion without hierarchy/contextual background is impossible. Reduce the pressure. Make it easier to speak out.* [J1]

The interviewees mentioned ways of reducing the negative influence of hierarchy in design discussion:

> *Making the people in charge understand/be aware of this hierarchy issue*. [J1]
> *Working on team setting (but not the same department/hierarchy only).* [J1]
> *Sending one designer to a team for facilitation in a team. Let them speak, let them pile up an idea. If the people in the low hierarchy do not speak out, keep a queue for them to speak out.* [J1]

However, hierarchy seems to have a positive influence. The importance of having a leader in a discussion was reported.

> *In every social group, there are natural leaders, sometimes more than one. Having a leader makes people wake up: participation by reaction. When leadership is removed from a group, the group will be anarchic; someone naturally takes a lead, or there is no-leadership.* [E2]

All interviewees mentioned that no leadership often happens among Japanese participants. An interviewee reported a case where a group with a hierarchy worked better than groups without a hierarchy in a company where the hierarchy is not strict.

> *Three groups; two groups no hierarchy at all, it is only people from different departments, they are all people from pretty much an equivalent level. We had a lot of problems to make them ideate because it is a bit slow. Nobody is taking the lead. Like all waiting on the other to do something. [..] In one group we had one executive, so it is people from the same level and one executive. This group created maybe three times more ideas than the other two. Because there was an executive,*

> *because there was a leader. You know he instinctively kind of lets them think and the others kind of followed.* [E2]

The interviewees mentioned that the no-leadership among a group is a problem.

> *With Japanese participants, sometimes no one wants to take the lead, and it is a problem.* [E2]

When nobody takes the lead in a group, facilitators of the workshop get involved in the team to keep the discussion moving. It seems that having a proper hierarchy could be a way to make people more creative.

The mindset in conducting co-design sessions with Japanese participants

The interviewees mentioned the organisation of the workshop in general and the importance of ice-breaking.

> *More ice-breaking time (than with Spanish participants) but softer for Japanese participants. Introduce the guy on your left that is enough. The level of effort and effect is equivalent.* [E1]

When preparing design workshops in Japan, you should prepare very carefully. Three interviewees shared this opinion. They also mentioned that they flexibly change the timetable and content of the workshop in the middle of the workshop.

> *The preparation takes a lot of time. Especially in Japan where you always need a plan B.* [J1; E1, E2]

Conclusions from the interviews

The interviews revealed three main findings. First, Japanese participants tend not to speak out as much as Europeans do in co-design workshops. The discussion dynamics of Japanese participants are fragile; they need time to start a conversation and should be encouraged to speak out during design discussion.

Second, Japanese participants seem to be intimidated by the presence of professional designers. The presence of professional designers makes Japanese participants regard themselves as non-experts in the design discussion and they choose not to speak out because they think their idea is not worth being shared or discussed with experts.

Finally, the hierarchy can have both positive and negative influence on the activeness of people in lower hierarchical positions. In most cases, according to the interviewees, the presence of people in a higher hierarchical position leads people in a lower position—or those perceived as such—to remain silent during the discussion. The people in lower positions may think that their ideas cannot impact the discussion outcome because they believe that only the opinion of people in a higher position can impact the discussion. People in lower positions may also think that their ideas will be negatively judged by people in higher positions regardless of the actual quality of their ideas. However, letting people follow the facilitation of hierarchically higher positions may encourage the discussion. Influence seems to be determined by the personality of people in higher positions or the culture of the organisation. The culture of an organisation is a result of daily relationships at work. For example, in an organisation where people in lower positions actively join the discussion in conventional meetings, the influence is positive.

Professional designers deal with these issues by manipulating group members, increasing the awareness of people in higher positions, controlling the interaction between facilitators and participants and preparing a well-elaborated plan for workshops. They discuss these with counterparts, e.g. client companies, to manipulate group settings and an increase of awareness before the workshops. During workshops, they carefully support Japanese participants in speaking out by facilitating group discussion and sometimes changing workshop facilitation.

STUDY 2: Impact of power distance on collaboration in co-design workshops

Objective

The interviews with designers suggested that, in a Japanese context, the collaboration within a co-design group would be affected by the presence of a person 'with authority' (e.g. a professional designer), while this would not be the case in a Western context. The aim of Study 2 is to investigate the impact of hierarchical differences, or where they are perceived as such, in a co-design workshop group. Our central hypotheses are the following:

In a co-design group with non-designers from a high power distance index (e.g. Japan):

H1. The presence of an expert (designer) might create a hierarchy in the group.

H2. The presence of an expert (designer) might hinder the participation of non-designers.

Methodology

To highlight the differences between a high power distance index (PDI) non-designers and low PDI non-designers, we organised and observed co-design workshops with groups of high or low PDI. To test the effect of the presence of an expert (designer) in groups, each session with one group was divided into two design tasks, one with four non-designers and one with three non-designers plus one expert (designer).

Our analysis was based on both the quality of the collaboration method (Détienne et al., 2017) and the reactive token theory (Clancy et al., 1996). The quality of collaboration method is an updated version of the proposed multi-dimensional rating schemes of evaluating the quality of collaboration (Burkhardt et al., 2009; Détienne et al., 2008; Safin et al., 2010). It aims at measuring the quality of collaboration through the observation of behaviours and verbal interactions; it consists of eight categories: fluidity of communication, joint focus and mutual understanding, co-design and creativity, argumentation in problem-solving, distribution of different types of activities, coordination and distribution of roles across the participants and interpersonal relationships.

Because our study examined the dynamics of groups in Japan specifically, our methodological approach took into account the specificity of the Japanese language, which is its intensive use of the reactive token. In a cross-linguistic analysis of Japanese, Mandarin and English, Clancy et al. (1996) defined a reactive token as a short utterance produced by an interlocutor who is playing a listener's role during the other interlocutor's speech. In our study, the distribution of reactive token in verbal interactions between co-design participants enabled us to visualise the dynamics of the group.

Participants

Twenty participants were selected based on two criteria: (1) level of design expertise and (2) scores of power distance index(PDI). The level of design expertise was assessed through a questionnaire about the number of years of design experience. Sixteen non-experts, i.e. students from engineering/science departments of a Japanese university (age range 21-27, twelve male/four female participants), and four experts, i.e. two designers from design firms and two design educators from universities (age range 27-47, four male participants). The participants were carefully grouped so that the expert was always older than the non-experts and there was always one female and three male participants in the group.

The screening of PDI consisted of two steps. We first invited students from Japan and from 'Western countries' to apply. Then their PDI scores was assessed through a questionnaire developed for that purpose (Sharma, 2010). Only applicants with either low or high PDI scores were selected for the experiment; it was checked that the average score for both groups was significantly different with a Mann–Whitney U test (Z: - 2.57, d: 0.74). The selected participants consisted of eight students from Japan and eight students from Western countries (Norway, USA, Germany, Netherlands, Finland, and Sweden) (Table 4). The students selected as low PDI participants were temporal exchange students in a university.

Group	***Western countries (expected low PDI) average value (SD)***	***Japan (expected high PD) average value (SD)***	***Sig. (2-tailed)***
Power distance index scores	3.00 (0.52)	4.81 (1.10)	p = 0.009*

Table 4 Average power distance index scores for the groups of participants

'High PDI' sessions were held in Japanese, while 'Low PDI' sessions were held in English. The participants received a small reward for their participation. The experiment was approved by the ethics committee of Tokyo Institute of Technology.

Experimental Procedure

Each group of four participants was asked to join a 1.5-hours-co-design workshop and conduct a design task twice, with two different briefs and in two different conditions: with or without a design expert (Table 5). In the control condition (without a design expert), the participants were four non-experts (no or limited design experience) while, in the hierarchical condition, the participants were three out of the four non-experts from the control condition, plus one expert. The experts were introduced to the other participants as 'experienced design professionals'. Each 22-minute design task comprised three design steps: (1) Idea generation, where the participants were asked to generate as many ideas as possible individually (2 min) then in the group (8 min). (2) Idea selection, where the participants were asked to select one idea (10 min) and (3) Idea presentation, in which the participants were asked to sketch the selected idea and to present it (2 min). The second task followed a short break. In Design Task 1, the brief was: 'Imagine the shoes of the future' and in Design Task 2: 'Imagine the mirror of the future'. Briefs were kept simple so that the participants could quickly start ideating. The experimental design was counterbalanced, to avoid any order effect (Table 5). Participants with similar PDI scores were randomly assigned to follow one of the two settings.

	PDI	***Design Task 1***	***Design Task 2***
		Condition	Condition
Group 1 (n=5)	High	Control (S1, S2, S3 + S4)	Hierarchy (S1, S2, S3 + Ex)
Group 2 (n=5)	Low		
Group 3 (n=5)	High	Hierarchy (S1, S2, S3 + Ex)	Control (S1, S2, S3 + S4)
Group 4 (n=5)	Low		

* S1, S2, S3, S4: non-expert, Ex: expert

Table 5 Conditions and briefs in the design sessions

Participants were provided with paper and pens. The experiment took place in a neutral room, with no visual stimuli that could affect creativity, such as pictures on the wall. (Figure 1)

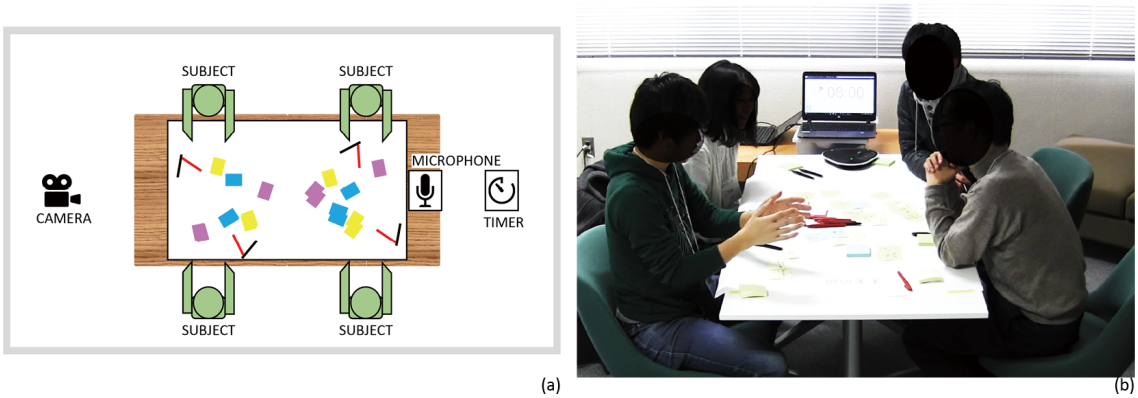

Figure 1 (a) Experimental setting, (b) Scene of the experiment

Data collection and analysis

The collected data consisted of questionnaires and videos of the design workshops. The first hypothesis was tested through three sub-hypotheses, with the metrics listed in Table 6.

H1-1 Hierarchy - Actual Group Dynamics. The group dynamics were assessed through the number of utterances of reactive tokens. In a high PDI group, the number of positive reactive tokens from non-experts towards experts were expected to be more than among non-experts.

H1-2 Hierarchy - Task Management. In a high PDI group, it was expected that the expert would organise discussion where non-experts would follow while, in a low PDI group, both non-experts and experts could lead the discussion. These were measured by video analysis of the 'distribution of task management roles', utterances of 'task management', and the number of ideas written on sticky notes.

H1-3 Hierarchy - Perceived Group Dynamics. The group dynamics as perceived by the non-experts was assessed through the questionnaire. It was expected that the difference in actual group dynamics differentiates participants' subjective perception qualitatively and quantitatively.

H2 – Participation was tested through the evaluation of the total amount of utterances produced by participants in each session.

Hypothesis	***Sub-hypothesis***	***Data***	***Metrics***
H1: Hierarchy	H1-1: Actual group dynamics	Video	Number of utterances related to 'Positive Reactive Token feedback' (Table 8)
	H1-2: Task management	Video	Number of utterances related to 'Task management' (Table 8) Behaviours: 'Writing on a sticky note', 'Moving a sticky note'
	H1-3: Perceived group dynamics	Questionnaire	Perception of quality of collaboration (Annex A1)
H2: Participation	Participation relevant to idea generation	Video	Duration of speech related to 'Proposing a new idea' and 'Argumentation' (Table 8)

Table 6 Hypotheses and metrics used in the experiment

The collected data consisted of questionnaires and videos of the design workshops. The analysis included the questionnaires of the twelve non-expert participants who took part in both design tasks, one with an expert and one without. As for the video analysis, all videos with all subjects were taken into account.

Questionnaire. Questionnaires on the quality of collaboration were given to measure each participant's perception of the collaboration process and outcome. The questions were retrieved from the 'QC2' questionnaire aimed at enabling evaluators to measure the quality of collaboration (Détienne et al. 2016). QC2 has thirty-three questions in eight dimensions which belong to three categories. We kept questions which are both relevant to the design task and possible to be evaluated by the participants themselves.

Each item was assessed on a five-point Likert scale, where a higher score meant a stronger agreement. The questionnaire also had space for free comments regarding the session (attached Annex. A1). The questionnaires were given in English or Japanese so that the participants could accurately understand each question.

Video. For the analysis, we used the videos of 'idea generation' activity (8 minutes). The video was coded by following the categories in Table 8. Every second of the scene was analysed. The categories were generated by the authors to evaluate both the quality of collaboration and participation of each participant. The codes are a mix of the quality of collaboration (Détienne et al. 2016) and the reactive token theory (Clancy et al. 1996). We use 'fluidity of communication', 'co-design and creativity', 'argumentation in problem-solving', 'coordination' and 'distribution of roles across the participants'. 'Sustaining joint focus and mutual understanding' and 'sustaining joint focus and mutual understanding' were not evaluated because the limited time of activities and limited tools were available for the participants. 'Interpersonal relations' was evaluated through participants' perception.

Based on the research of Clancy et al. (1996), verbal utterances with a positive meaning, e.g. 'exactly', were considered as positive reactive tokens. As the participants of low PDI groups were from different countries, their reactive token should not have been linguistically considered the same as a native English speaker. However, we analysed reactive tokens of low PDI participants because this research focuses on exploring the behaviour of Japanese participants. We believe reactive tokens by low PDI countries can be considered as a reference to discuss the behaviour of Japanese participants. We also counted how many times each person writes and moves sticky notes during idea generation.

Code	*Definition*	*Example from transcript*
Proposing a new idea	Explaining a new idea with the group	'I have three ideas…'
Argumentation	Discussing own or others' ideas	'That idea is similar to this idea'
Positive reactive token feedback	Back-channelling feedback to others' ideas conveying 'support'	'Exactly', Okay', 'Ah…', 'It makes sense'
Task management	Talking about the organisation of a discussion or calling a person to speak out	'Shall we share idea fast?' 'You can start'
Speaking	Other type of content	Greeting, etc.

Table 8 Codes used for video analysis

Results Overview of the interaction: Less speech generated by high PDI participants

The average duration of speech spoken by participants is shown in Figure 2. In the figure, 'High PDI_control' means the sessions of participants from high PDI scores without expert designers and 'Low PDI_hierarchy' addresses sessions of participants from low PDI score countries with expert designers. 'Non-experts' represent three non-experts who participated in the sessions. The value of 'non-experts' was calculated by multiplying the average of six non-experts (three non-experts per session) by three. 'Non-expert*/expert' represents the amount of an average non-expert's behaviour or speech in the condition of 'without' whereas it represents the value amount of an expert's in the condition 'with'. The figure shows that the total amount of speech produced by high PDI participants was lower than that of low PDI participants regardless of their nationalities. The non-experts' participations were decreased to around 55% in both groups. It shows that experts were dominant in idea generation. The content of the discussion is analysed in the following sections.

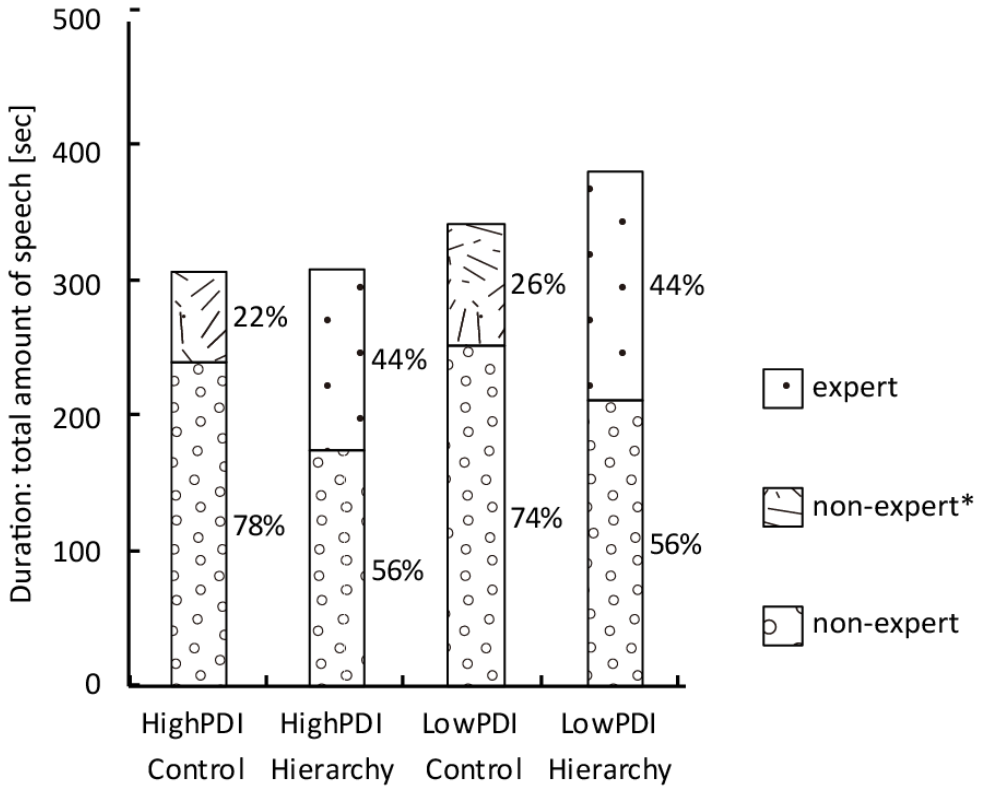

Figure 2 Average duration of speech during idea generation

H1-1 Concentration of backchannel towards design experts in high PDI groups

The analysis of reactive tokens reveals the different dynamics of discussion with experts depending on the PDI score. Tables 9 and 10 show the average of reactive token feedback among participants. In Table 9 and 10, 'from/to non-expert' indicates the reactive token spoke by a non-expert to a non-expert, 'from non-expert to expert' indicates the reactive token spoken by a non-expert to an expert and 'from expert to non-expert' indicates the reactive token generated by an expert to a non-expert.

As Table 9 shows, in high PDI groups, the amount of reactive tokens 'from/to non-expert' in hierarchy conditions (M 1.92, SD 1.83) were significantly less than that of control conditions (M 4.25, SD 4.52) whereas reactive tokens from non-expert to experts (M. 8.83, SD 5.00) were significantly more than the average of reactive tokens among non-experts in both hierarchy (M 1.92, SD 1.83) and control conditions (M 4.25,

SD 4.52). The reactive tokens from expert to non-expert was the least significant (M 1.17, SD 1.17). This data suggests that non-experts of high PDI groups reacted to experts significantly more than a reaction to another non-expert in a hierarchy condition and reaction in a no-hierarchy condition. It also shows that non-experts became significantly less active in reacting to another non-expert in a hierarchy condition than a no-hierarchy condition. Moreover, the expert reacted to non-experts significantly fewer times.

		From/to non-expert: hierarchy	***From non-expert to expert: hierarchy***	***From expert to non-expert: hierarchy***
	M (SD)	1.92 (1.83)	8.83 (5.00)	1.17 (1.17)
From/to non-expert: control	4.25 (4.52)	Z = -2.39 ES = 0.56 p = .017*	Z = -3.44 ES = 0.81 p=.001*	Z = -2.45 ES = 0.58 p=.014*
From/to non-expert: hierarchy	1.92 (1.83)	n/a	Z = -3.75 ES = 0.88 p=.000*	Z = -1.30 ES = 0.31 p=.193

Table 9 Average and standard deviation of the number of reactive tokens in high PDI groups

In low PDI groups, Table 10 shows, the amount of 'from non-expert to expert' (M 4.83, SD 2.93) are significantly more than the amount of 'from/to non-expert' in control (M 3.00, SD 2.63) and in hierarchy conditions (M. 2.33, SD 1.78). The data suggest that non-expert of low and high PDI groups also reacted to experts significantly more than a reaction to another non-expert in a hierarchy condition and a no-hierarchy condition. In contrast to high PDI groups, it suggests that non-experts did not become significantly less active to react to another non-expert in a hierarchy condition than the no-hierarchy condition. The expert reacted as many non-experts did among non-experts.

	From/to non-expert: hierarchy	***From non-expert to expert: hierarchy***	***From expert to non-expert:***

				hierarchy
	M (SD)	2.33(1.78)	4.83(2.93)	2.83(1.94)
From/to non-expert: control	3.00 (2.63)	Z = -1.59 ES = 0.38 p=.111	Z = -2.82 ES = 0.66 p=.005*	Z = -0.17 ES = 0.039 p=.867
From/to non-expert: hierarchy	2.33(1.78)	n/a	Z = -3.40 ES = 0.80 p=.001*	Z = -1.06 ES = 0.25 p=.291

Table 10 Average and standard deviation of the number of reactive tokens in low PDI groups

Related to H1-1: In high PDI groups, it was expected that the expert would organise discussion and non-experts would follow while, in low PDI groups, both non-experts and experts could lead the discussion.

H1-2: Designers naturally take the lead in both PDI groups

The experts naturally organise the discussion. The number of utterances regarding task management, i.e. 'Shall we share ideas first?', were counted during idea generation. Figure 3 shows the number of each behaviour. The percentage in the figure indicates the ratio a category occupies in a condition. Theoretically, in any session without expert designers, the ratio of 'non-experts' is 75% and 'non-expert/expert' is 25% assuming all non-experts act the same as others. Figure 3-a shows the number of sticky notes moved by a participant. The total amount of behaviours by all participants in the sessions with experts are more than the amount without expert designers at both PDI conditions. In sessions without expert designers regardless of PDI groups, the expert designers occupy around half of the total behaviours. Figure 3-b indicates who writes a memo in idea generation sessions. The total amount of expert designers was increased in high PDI sessions. The expert occupied more than 25 % of activities.

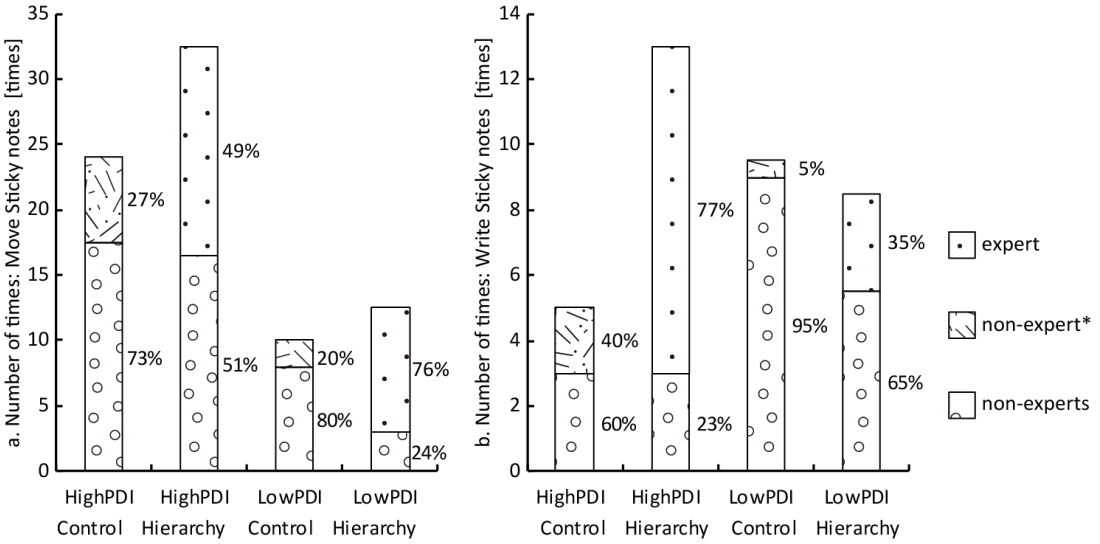

Figure 3 Behaviours regarding task management

Figure 4 shows the number of utterances regarding the management of discussion. The experts talked for around half of the total amount in low PDI sessions, whereas the experts talked 90% of the total amount in high PDI sessions. The figure shows that experts naturally took the lead in sessions. It seems the presence of experts influenced the high PDI participants more. This is consistent with H1-2: in high PDI group, the number of the positive reactive tokens from non-experts towards experts was expected to be more than that among non-experts.

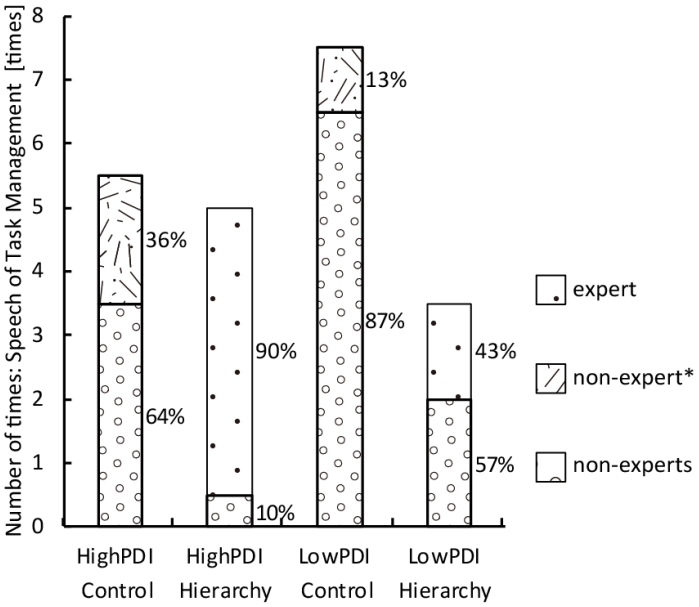

Figure 4 Utterances regarding task management

H1-3: Participants' perception of the quality of collaboration and group creativity

We found few significantly different results between high PDI and low PDI groups when they collaborated with design experts (Table 11). The results show that participants from high PDI groups found that they had a more friendly discussion with experts than participants of low PDI groups. Consequently, participants from high PDI groups felt it was easier to talk with the group members after the experiment than participants of low PDI groups.

	High PDI group Average (SD)	***Low PDI group Average (SD)***	***Sig. (2-tailed)***
How should the interpersonal relations between group members be described?' (1. conflictual - 5. friendly)	4.67 (0.52)	3.62 (0.52)	Z = -2.45 ES = 0.71 p = 0.026*
Was it easier to talk with the group members after the experiment than before?' (1. not at all - 5. extremely)	4.50 (0.55)	3.33 (0.82)	Z = -2.30 ES = 0.66 p = 0.026*

Table 11 Questionnaire results with significant differences between groups

Participants had a space for free comments within the questionnaire. Filling in the section was not mandatory. Although a limited number of comments was collected, it gave us some qualitative indications of how participants were affected by the designer's presence. In one of the low PDI groups, a participant who took part in two design activities, first without a design expert, then with a design expert, wrote:

> 'When there is a designer in the group, he naturally takes the lead. Without him, we would have combined more things.' – [low PDI]

In another group, someone (who started with a designer) said after the experiment that without a designer:

> 'You removed the individual who was a big control figure which messed us up on timing'. – [low PDI]

These quotes show that even the low PDI group was affected by the designer's presence, it suggests that having a design expert was a benefit for leadership more than creativity. Indeed, they paint him/her as an influential figure helpful for making decisions, but they were cut by the timer without him/her which shows that they still generated lots of ideas.

In the high PDI group, after the session with the designer, one participant wrote:

> 'I felt that we had tended to always follow designer's opinion'. – [high PDI]

This quote shows that the expert's presence had a negative influence on his/her own and group creativity. Another participant wrote:

> 'I found it was fun.' – [high PDI]

After the session without designer as his/her first session, a participant wrote:

> 'It was fun, and I was a bit nervous.' – [high PDI]

This indicates he/she got influenced negatively by the presence of the expert.

H2: Fewer ideation activities by non-experts in high PDI groups

The amount of speech regarding idea generations also varied in different conditions. Figure 5-a shows the total amount of code, proposing a new idea, in which participants shared new ideas with group members. Figure 5-b shows the amount of speech code 'Idea Argumentation', which represents idea argumentation and discussion on shared ideas. In the figure, 'High PDI_hierarchy' shows average scores of high PDI groups with design experts and 'Low PDI_control' shows average scores of low PDI group without design experts. The total amount of ideation speech was increased at high PDI groups with design experts where the amount was decreased in low PDI conditions.

However, the total amount of argumentation of ideas was decreased in high PDI conditions while the amount in low PDI conditions was increased. Overall, high PDI group participants tend to talk about the idea rather than focusing on generating ideas without experts, while low PDI group participants focus too much on generating ideas without discussing the idea. Experts seemed to balance the number of activities of proposing new ideas and debating ideas. The total amount of ideation relevant activities, both ideation and idea argumentation, are shown in Figure 6.

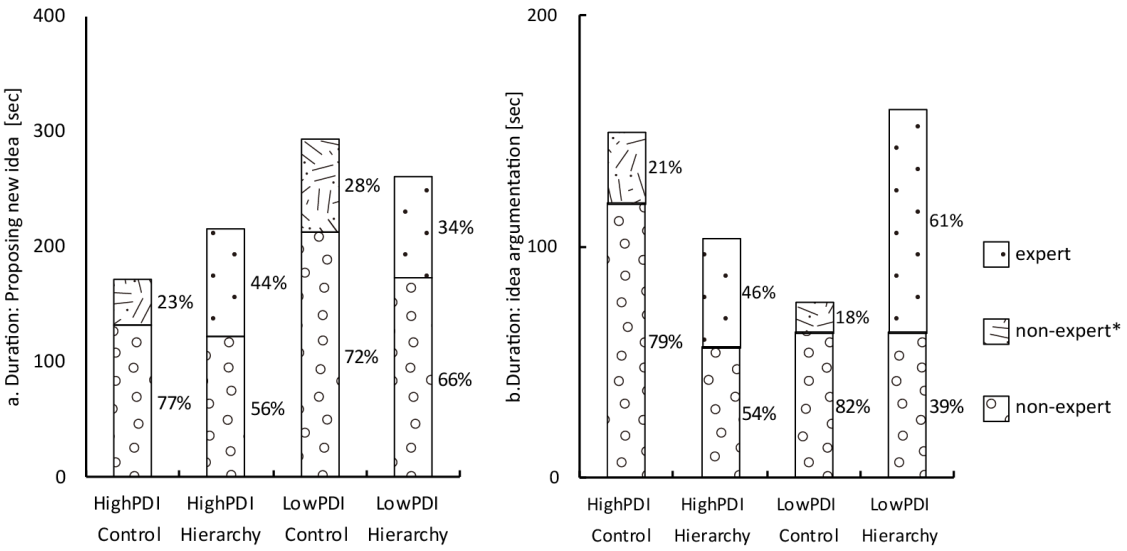

Figure 5 Ideation activities and argumentation

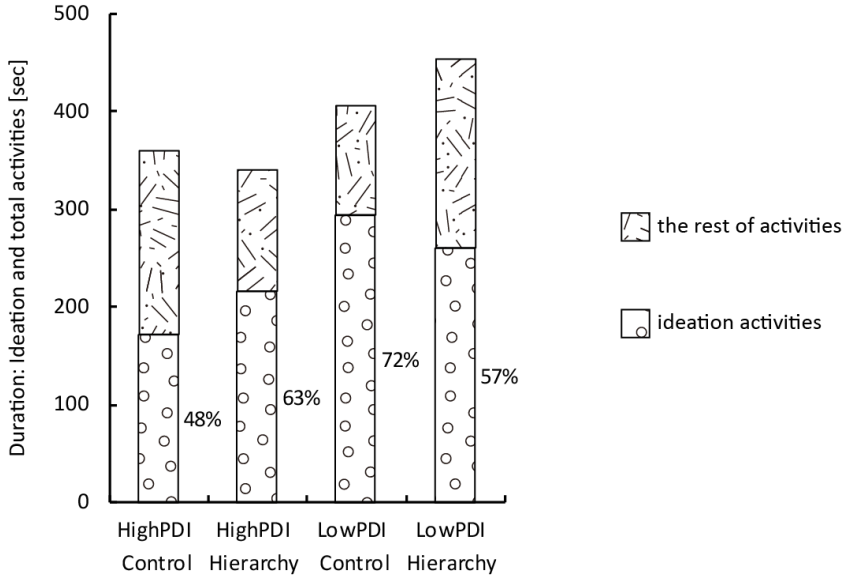

Figure 6 The ideation activities, 'proposing idea' code and other speech

In three out of four groups, each participant first shared ideas which were generated in an individual brainstorming session. Every participant had chances to discuss their ideas in turn. In one session (low PDI groups with an expert), the participants immediately built on another's idea from the beginning. We removed the speech of the first idea sharing by each participant because the presence of expert designers may not influence the turn. As one of the low PDI groups with expert designers did not fit in the calculation, the average value of 'Low PDI_hierarchy' is the exact value of the other low PDI group. Figure 7 shows the amount of utterances related to 'proposing a new idea'. In high PDI groups, more than half of the speech related to proposing new ideas came from an expert, while it was evenly shared by all participants in a low PDI group. Overall it probes H2: The presence of an expert (designer) might hinder the participation of non-designers.

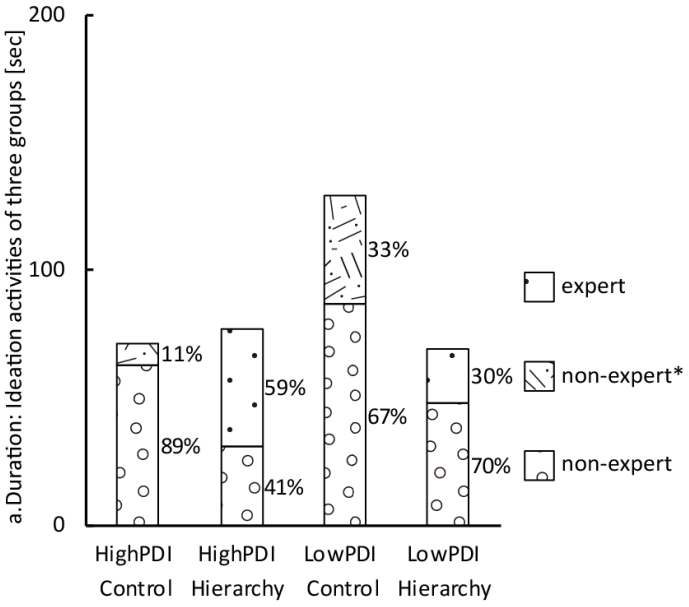

Figure 7 Average amount of ideation activities

	High PDI (Japan)		Low PDI	
Hypothesis Metrics	control	hierarchy	control	hierarchy
H1-1: Actual group dynamics Total amount of speech [sec] (cf. Figure 2)	244/311 (78%)	176/314 (56%)	256/347 (74%)	215/387 (56%)
H1-1: Actual group dynamics (cf. Table 9.10) Reactive tokens from non-expert to expert	n/a	Concen- tration	n/a	more
H1-2: Task management	18/24	17/33	8/10	3/13

Moved a sticky note [times] (cf. Figure 3 a)	(73%)	(51%)	(80%)	(24%)
H1-2: Task management Write a sticky note [times] (cf. Figure 3 b)	18/24 (60%)	17/33 (23%)	8/10 (95%)	3/13 (65%)
H1-2: Task management (cf. Figure 4) Speech regarding task management [times]	3.5/5.5 (64%)	0.5/5.0 (10%)	6.5/7.5 (87%)	2.0/3.5 (57%)
H1-3: Perceived group dynamics Interpersonal relationship (cf. Table 11)	n/a	friendly	n/a	conflictual
H1-3: Perceived group dynamics Easiness to talk after the **session** (cf. Table 11)		easier		no difference
H2: Participation relevant to idea generation Amount of new ideas proposed, four groups [sec] (cf. Figure 5)	132/172 (77%)	121/216 (56%)	212/294 (72%)	173/261 (66%)
H2: Participation relevant to idea generation Amount of idea argumentation, four groups [sec] (cf. Figure 5)	119/150 (79%)	57/104 (54%)	63/76.5 (82%)	97/160 (39%)
H2: Participation relevant to idea generation Amount of ideation activities, three groups [sec] (cf. Figure 7) *2	63/71 (82%)	46/77 (48%)	87/130 (73%)	48/69 (65%)
H2: Participation relevant to idea generation Amount of ideation activities/total amount of speech [sec] (cf. Figure 6)	172/360 (48%)	216/341 (63%)	294/406 (73%)	261/455 (57%)

1. In the table, 'a'/'b' means that a is the total amount of three non-experts in each condition and b is the total amount of all four participants in each condition. The percentage shows the ratio of three non-experts in four participants.
2. The participants in three groups first shared their idea one by one while one group started building on others' ideas from the beginning. The amounts excluded utterances of the first idea sharing.

Table 12 Summary of the results of the experiment

Discussion

Less verbal interaction among participants in high PDI groups regardless of the presence of either designers or hierarchy in a group

Based on the analysis of both PDI groups' videos, we have found that the high PDI participants did not speak as much as low PDI participants (high PDI: 311-314, low PDI: 347-387 cf. Figure 2). This is the same trend as in research on counting utterances in focus group discussions between a group of South Korean participants and a group of Dutch participants (Lee and Lee 2009), which suggests that regional cultural orientation influences design activities in a similar way regardless of the difference in national culture between South Korea and Japan. This could be because ice-breaking activities were not included in the experiment procedure due to time constraints. Most

participants did not know each other before the experiment, and the participants might have been nervous to work with someone whom they did not know well, as has been identified in the literature review (van Boeijen 2015). Lab-based experiment setups could be another reason to hinder the participation of high PDI groups. They might have been uncertain about the purpose of the experiment as the purpose was kept hidden to keep it from influencing their behaviour. It could lead to a situation where the participant did not trust the experimenters, which was one of the barriers reported in our interview and related studies (Lee and Lee 2009).

An expert-presence created hierarchy, which is a comfortable environment for both experts and non-experts, was naturally created in high PDI sessions

The analysis of reactive token feedback shows similar trends in non-expert behaviour in both PDI groups, which shows significantly more reactive token feedback from non-experts to experts than feedback from experts to non-experts (cf. Table 9, 10). However, it also shows the differences in expert behaviour. Experts of low PDI groups spoke as many reactive tokens as non-experts did among non-experts (from expert to non-experts: 2.83; among non-experts in control: 3.00, p: 0.867, Z: -0.17, cf. Table 10). In contrast, experts in high PDI groups used significantly less reactive tokens towards non-experts (from expert to non-experts: 1.17; among non-experts in control: 4.25 p: 0.014, Z: -2.45, cf. Table 9). The unbalanced reactive token feedback suggests that hierarchy, where experts became a higher position and non-experts became a lower position, was created in high PDI groups It probes H1-1: In high PDI groups, the number of positive reactive tokens from non-experts towards experts were expected to be in higher number than that among non-experts. As the reactive token feedback encourages people to speak out (Sannomiya 2004), the experts in high PDI conditions might have been naturally and strongly encouraged to speak out. The influence of reactive token

feedback results in dominant speech by experts in high PDI conditions.

Presence of design experts intimidates non-designers in high PDI groups, whereas it stimulates them in Low PDI groups

The design expert tends to lead the discussion and participants were naturally aware of his influence regardless of PDI differences (cf. Figure 3, 4). This was partially consistent with H1-2: In high PDI groups, it was expected that the expert would organise discussion and non-experts would follow while, in low PDI groups, both non-experts and experts could lead the discussion. However, they reacted differently. The subjective questionnaire suggests that in high PDI groups, it seemed less conflictual as the non-designers felt comfortable following the designer's lead (high PDI: 4.67, low PDI: 3.62, p:0.026, cf. Table 11). They may have seen this as an opportunity to follow their instructions and a student-teacher relationship settled between the participants and the expert. Reactive token analysis (cf. Table 9, 10) shows that it was more difficult for high PDI people to express opinions or to offer opposition to the expert, as one of the participants had also commented. This explains the perceived difference in interpersonal relationships (high PDI: 4.67, low PDI: 3.62, p: 0.026). It probes H1-3: the different perception of group dynamics depending on the PDI score.

The involvement of a design expert negatively affected their ability to speak out freely. As a result, the amount of speech generated by non-experts during idea generation decreased (cf. Figure 5, 7). Notably, the contributions of high PDI group participants in idea generation activities decreased more than in low PDI group participants. This shows that the presence of experts created a hierarchy in group discussions and intimidated non-designer contributions. It also resulted in less active participation of high PDI non-experts in a hierarchy condition, which is consistent with H2: The presence of an expert (designer) might hinder the participation of non-

designers. This result is in line with the observation of the focus group that reported a higher contribution from South Korean than Dutch participants (Lee and Lee 2009).

General Discussion

Impact of cultural difference on co-design facilitation

The influence of value orientation regarding the power distance index on idea generation activities in the co-design workshop was studied. Our interview with four professional designers supported that the six barriers reported in literature through students' projects and laboratory-based experiments exist at design practice in the Japanese context. The six barriers were the outcomes of studies conducted in China (Hao et al. 2017), South Korea (Lee and Lee 2009) and Japan (Yasuoka, Nakatani, and Ohno 2013; Détienne et al. 2017), and the six barriers are shared in an East Asian context. The six barriers are: (1) Sharing ideas freely with people in a higher hierarchical position, (2) collaborating with strangers, (3) trust with a facilitator, (4) harmony of group, (5) ambiguous assignment and (6) lack of a 'common language'.

Among the six barriers, our interviews highlighted that 'Sharing ideas freely with people in a higher hierarchical position' was crucial. It also suggested that hierarchy could be formed not only by the hierarchy in organisations, i.e. superiors and subordinates, but also by different social positions, i.e. a designer—the expert with skills and knowledge—and non-designers. Our experiment carefully observed how the presence of different social positions in groups impacts collaboration by looking at a value orientation, PDI. It showed that **a h**igher number of reactive tokens towards expert from non-experts helped an expert to naturally speak more and non-experts to be inactive in groups of participants having a high PDI index. The result of the experiment supported the interview findings. The observed hierarchy by experts gives an

explanation of higher facilitator role among participants from South Korea than from the Netherlands, as reported by Lee and Lee (2009). It was observed that the hierarchy prevents open and equal participation, which are a presumption of a co-design approach (van der Velden and Mörtberg 2014; Yasuoka, Nakatani, and Ohno 2013). With those barriers in mind, the practitioner may conduct better facilitation of co-design in East Asia.

How to facilitate co-design workshops in an East Asian context

Our findings together with related studies (Lee and Lee 2009) suggest that co-design in East Asia cannot be conducted in the same way as in a Scandinavian context. The collaboration within an East Asian group could be improved by balancing three co-design activities known as Telling, Making and Enacting (Brandt, Binder and Sanders, 2012). Making and Enacting may significantly help engage participants who are reluctant to talk and orally express opinions. We can also reconsider the balance of individual works and group works in co-design workshops. Introducing individual work may give equal speaking opportunities, as the participants share their idea one by one. However, from a practical point of view, Telling cannot be totally removed from co-design activities, and generative activities in groups plays a significant role in co-design. Therefore, we formulate six ways to encourage the active participation of East-Asian people in co-design workshops based on our results and literature review. (1) Having more icebreaking time but less density of activity to tackle 'collaboration with strangers' and 'no trust with facilitator'. The importance of icebreaking has also been suggested in the literature (Lee and Lee 2009; van Rijn et al. 2006). Our findings highlighted the adjustment of the density of activities to a culturally acceptable level. Our results suggest that: (2) Trust issues can be mitigated by sensitising the purpose of design workshops beforehand. (3) Showing respect to the efforts of participants is also

expected to build trust between facilitators and participants (van Rijn et al. 2006) and it could also make participants actively participate by being convinced that they are experts rather than designers are. (4) Showing examples and divided design tasks help to tackle the ambiguity of design tasks (van Rijn et al. 2006). (5) Preparing an alternative plan/schedule in case the initial plan does not work. In case participants are not moving forward with design activities, facilitators should quickly adapt their plan. Not showing facilitators' confusion would address trust. An elaborated plan B helps to avoid the ambiguity of a design task. (6) Being careful to have or not to have a hierarchy in groups. Removing hierarchy from groups may end in inefficient interactions; thus, mitigating the negative influence of hierarchy seems to be a better option.

Our findings expanded the perception of hierarchy. A hierarchy can be formed by positions in the organisation, i.e. superiors and subordinates, and differences between social positions in groups, i.e. design professional and non-designers. The facilitator should make participants in higher positions aware of the risks of hierarchy and/or of 'reactive tokens' towards people in higher positions. Facilitators can also intervene in group discussion to prevent the forming of hierarchy in groups. To deal with the difference in social positions, hiding a professional background could avoid the formation of hierarchy. For that purpose, the original definition of co-design has to thoroughly explained to a Japanese audience as a collaboration between diverse "experts", including non-designers who are potential end-users and "experts of their experiences" (Sleeswijk Visser et al., 2005). By highlighting the fact that all participants in a co-design workshops are experts, the negative effect of hierarchy on the group dynamics could be mitigated. As underlined by Steen et al. (2011), for co-design efforts to be effective, it is critical to give participants the appropriate roles in co-design

activities. With this in mind, we advocate allocating roles to co-design workshop participants that may help mitigating the effects of the perceived social position of others, and maybe play with these roles. Role allocation and role play could be achieved through gamification, as suggested by a study on creative games in different socio-cultural contexts (Yasuoka, Nakatani, and Ohno 2013), or by manipulating social identity cues, as suggested by a study on group creativity (Guegan et al, 2017).

Limitations of the study

Since the interviews were conducted with designers from the same company, minor aspects of co-design workshops might have been magnified. Also, as the interviewees work in a for-profit company, they might not share some of their know-how, consciously or unconsciously. Further investigation in different contexts would enrich the description of co-design workshops.

In the lab-based experiment, the sample of participants involved in the workshop (20) was somewhat limited, and the participants in low PDI groups were recruited from the same university, which may limit the potential diversity of value orientation. Also, the design experts were different in each group; their characteristics may have influenced the group dynamics and workshop outcomes.

Conclusion and future work

The influence of value orientation on idea generation activities in co-design workshops was studied through interviews and experiments. Our study combined both data from design practice, through interviews with professional designers, and data from a laboratory-based experiment, to give a comprehensive view of co-design activities in a given cultural context. The interviews supported the six barriers identified in students' design projects and design practice (Lee and Lee 2009; van Rijn et al. 2006; Yasuoka,

Nakatani, and Ohno 2013). We experimentally observed that the presence of a designer created a hierarchy in a co-design group with non-designers, which is consistent with the interview findings. The experiment observed how value orientation impacts design collaboration by recruiting participants based on Hofstede cultural dimensions and behavioural analysis. The quality of collaboration method (Détienne et al. 2008) has been enriched by the application of the reactive token theory into video analysis of design activities; this original approach allows to investigate the impact of value orientation on co-design rigorously and to highlight specific cultural differences in co-design, discourse and behaviour. Our methodological approach allows mapping the findings in a Japanese context to other cultural contexts which share similar value orientation regarding social interactions, i.e. high power distance scores, such as East Asia.

Our findings suggest the necessity of culturally-aware design tools for generative activities in an East Asian context. Notably, our research highlighted that argumentation is crucial in co-design group discussion and highly dependent on the socio-cultural context and value orientation of the participants. Participants with a high power distance score are reluctant to engage in active argumentation when discussing ideas, directly judging others' ideas and expressing disagreement in front of others, especially when others are in a higher social position. Our study showed that these behaviours regarding participation in argumentation and expression of disagreement impacted the discussion negatively. For other purposes than co-design, it has been shown that gamification (Yasuoka, Nakatani, and Ohno 2013) or clothing (Guegan et al., 2017) could impact social dynamics in creative activities. Inspired by these findings, our further work will propose a unique co-design method based on role play and

gamification, tailored explicitly for socio-cultural contexts where disagreement cannot be directly expressed.

With the objective of enabling cross-cultural design collaborations, we will also further examine co-design activities that involve participants with different value orientation in diverse groups made of Eastern and Western participants. In a study about the effects of ethnic group cultural differences on cooperative and competitive behavior on a group task, groups made of students from the same American "ethnic group" chose more competitive behavior than groups made of students from various ethnic groups (Cox, Lobel and McLeod, 1991). The study suggests that socio-cultural diversity in groups influences individual behaviour and that the behaviour of participants in diverse co-design groups might differ from their behaviour in a culturally-homogeneous co-design group.

Overall, our findings have the potential to inform the development of tailor-made co-design methods which are eventually expected to help designers and non-designers collaboratively produce valuable outcomes for the society, irrespective of their value orientation.

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Annex.

A1. Questionnaire used in Study 2, based on [Détienne et al., 2008]

No.	***For the following statements and questions, please circle a number. Example:***	***strongly disagree***	***1***	***2***	***3***	***④***	***5***	***strongly agree***
1	To what extent were there silences in discussion?	not at all	1	2	3	4	5	many
2	How did you participate in discussion?	passively	1	2	3	4	5	actively
3	How should the interpersonal relations between group members be described?	personal conflict	1	2	3	4	5	friendship
4	Was it easier to talk with the group members after the experiment than before?	strongly disagree	1	2	3	4	5	strongly agree
5	How would you prefer to do ideation?	*by myself*			or			*in group*
6	Do you think your group was effective during ideation?	strongly disagree	1	2	3	4	5	strongly agree
7	Do you think no matter who is a member of group, this way of ideation is effective?	strongly disagree	1	2	3	4	5	strongly agree
8	If you disagree with no.7, why? And who do you think should be in the group?							
9	To what extent did your group propose creative ideas?	none	1	2	3	4	5	many
10	To what extent did you build on each other's ideas?	rarely	1	2	3	4	5	a lot
11	Are you satisfied with the amount of ideas you personally made during the ideation?	strongly disagree	1	2	3	4	5	strongly agree
12	Did you evenly evaluate the idea no matter who generated it?	strongly disagree	1	2	3	4	5	strongly agree
13	Are you satisfied with the final solution your group made?	strongly disagree	1	2	3	4	5	strongly agree
14	How was your motivation to this brainstorming?	low	1	2	3	4	5	high
15	How should your motivation in discussion be described?	forced	1	2	3	4	5	naturally motivated

"Free comments about the session (e.g. about group dynamics, about your relationship with other participants during the session, about your feelings during the session...)".