

Fostering Trust-based Relationship between Self-care Users and Home Medical Device in Thai and Japanese

Research on the Methods for Incorporating Social Roles in Blood Pressure Monitor to Increase Thai and Japanese User's Perception of Trustworthiness

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Abstract: This paper presents a cross-cultural research on the perception of trustworthiness in self-care home medical device - in particular, blood pressure monitor - in Thai and Japanese young adults. The study focuses on the method of incorporating social role image into the device to strengthen the image of trustworthiness, and its effects on Japanese and Thai users.

The emerging challenges in home medical device design call for the integration of trustworthy image in order to help alleviate the feeling of fear and worrying of non-professional users when interacting with medical devices. This research focuses on one particular methodology for creating perception of trustworthiness in technological agent: the incorporation of social role image. The first part of the research includes a cross-cultural survey (Thai and Japanese) on trustworthiness impressions of 7 social roles that are related to home medical products. The second part is comprised of an experiment to investigate different methods of incorporating "Caretaker/Nurse" social role into blood pressure monitor (BPM)'s cuff, and their effectiveness in conveying impression of trustworthiness of BPM to Thai and Japanese young adult users. The result shows no significant differences in direct trustworthiness rating between designs with social role image and design without, in both Thai and Japanese. However, there are significant changes in mood and ratings of components that are found in literature reviews to be related to perception of trustworthiness.

Keywords: Trustworthiness, Home medical device, Social roles, Cross-cultural, Blood pressure monitor

1. INTRODUCTION

The perception of trustworthiness is central to creating “trust” between users and devices. Trust is a complex phenomenon that lies at the foundation of interpersonal relationship and how we interact with the world around us (Simpson, 2007). The targets of trust range from people with close personal relationship to more abstract ideas such as political institutions, enacted law and in technological systems and products existed in our everyday life. By trusting technology, the need to fully understand how it works and to consider the many different factors that affect its operation is eliminated. Although the absence of understanding can have detrimental effects, it also works to help reduce complexity and allows us to use technology more smoothly and efficiently.

The complexity of trustworthiness perceptions is also attributed to the contextual and cultural factors involved. For example, a Japanese person may find a colorful, friendly-looking medical device trustworthy, but Thai person might think otherwise. Hence, accounting for cultural differences is an important point when designing the device to look trustworthy.

The researches on how to create an image of trustworthiness in technological device have been few, with most focusing on digital applications or branding. As such, there is a need to investigate how perception of trustworthiness could be incorporated into physical device. The emerging challenges in home medical device design also call for the integration of trustworthy image in order to help alleviate the feeling of fear and worrying of non-professional users when interacting with medical devices.

The objective of this paper is to investigate how self-care home medical device can be designed to convey a greater sense of trustworthiness and to compare and contrast the resulting effects between Thai and Japanese users. The paper will focus on one particular methodology of creating perception of trustworthiness in technological agent: *the incorporation of social role*.

2. INTERPERSONAL TRUST

2.1. Trust in Interpersonal Relationship

“Trust” or “interpersonal trust” has been recognized as an important facet of human’s relationship (Simpson, 2007). A simplified model by Hardin (1993 cited Sztompka, 1999, p. 55) defines trust relation as having three parts:

$$A \text{ trusts } B \text{ to do } X$$

This refers to when someone (A) trust or willingly rely on another person (B) to accomplish certain thing (X). This model explains in very simple terms how three different components of trust interact in the relationship, as well as suggests a relative nature of trust dynamic relationship. That is, person A specifically trust B with regards to X, but might not trust B with regards to other things.

2.2. Cognitive and Affective Trust

In an attempt to better understand interpersonal trust, Lewis and Weigert identified 3 bases of trust: cognitive, affective and behavioral. The 3 bases were later generalized into two types of trust: *cognitive* and *affective* (1985). Cognitive trust relies heavily on the objective, rational process, while affective trust is dependent on emotional aspects (Lewis & Weigert, 1985). Recent studies in marketing apply this distinctions to explain service relationships as followed:

Cognitive trust

This type of trust refers to the “customer’s willingness or confidence to rely on a service provider’s competence and reliability” (Johnson & Grayson, 2005, p.501). The trust assessment is based on knowledge and evaluation about the potential trustee’s ability and related likelihood of accomplishing certain goals.

Affective trust

On the other hand, affective trust is formed on the “basis of feeling generated by the level of care and concern” demonstrated by the trustee (Johnson & Grayson, 2005, p.501). The emotional trusting bond is often created through benevolent or caring responses from the trustee, which accumulate into personal experience that deepens over time.

3. TRUST AND TECHNOLOGY

3.1. Computer-are-Social-Actors (CASA) Paradigm

The rapid advancement in computational technologies has allowed human and technology to form extensive interactions with each other. The Computer-are-Social-Actors or CASA paradigm pioneered by Clifford Nass (1994) demonstrated that:

“...Once a computer (or a computer agent) looks, ‘talks’ (via either text or speech), or behaves like a person - however minimal these cues might be - people would respond to it as if it were a real person.”

- Lee & Nass, 2010

When applying the CASA approach to the concept of trust between human and computer, it was found that people’s perception of computer’s trustworthiness is subject to the same conditions in that of interpersonal trust (Lee & Nass, 2010). Several empirical studies relating to different aspects of trust formation were conducted to help better understand how trust relationship can be created between users and technology. For example, Tschannen-Moran & Hoy established that people are more inclined to trust those they perceive to be similar. (2000). In a study by Nass & Lee (2001, cited Lee & Nass, 2010), based on Tschannen-Moran & Hoy’s theory, text-to-speech system or TTS was used to create extrovert and introvert personality in computers (by altering intensity, frequency and speech rate). The speech was then synthesized, which acts as a reminder for people that they are, in fact, interacting with lifeless digital system and not a real person. Participants, a mixture of extrovert and introvert personalities, were split into two separate group. They were asked to listen to book reviews on an online shopping website, with one group being read by the extrovert voice and the other by the introvert voice. The result shows that, firstly, participants were able to distinguish between extrovert and introvert voices. Secondly, they prefer the voice that match their personality more. Moreover, even when the review texts were the same for both group, the participants rate the review as more trustworthy and trusted the reviewer more when the personality of the reader’s voice matches their own personality.

The study illustrates the possibility of fostering trust relationship between users and computer through integrating caring and extrovert/introvert personality into the interactive computer agents. It also allows for a better understanding of the emotional connection between technology and its users, and pave the way for developing trustworthy technology in the future.

3.2. Cues and Mindless Social Responses

Several studies in the CASA paradigm have showed that people respond to interactive technological agents, mindlessly and automatically, as social actors (Nass & Moon, 2000). The concept of mindless responses have been observed in many social situations (Langer, 1989, cited Nass & Moon, 2000). The process of eliciting these mindless social responses begins when individuals encounter an object that has “enough *cues* to lead the person to categorize it as worthy of social responses” (Nass & Moon, 2000, p. 83).

Although there have not been conclusive studies with clear findings about what kind of cues encourage users to identify a non-human, technological agent as social actor, it was observed that even primitive cues, such as text and voices, that are associated with human are powerful enough to elicit social responses (Nass, C., Steuer, J. & Tauber, E. R., 1994). Initially, 3 types of cue were identified: words for output, interactivity and filling of roles traditionally filled by humans (Nass & Moon, 2000). Fogg, in his book about persuasive technology (2003), later expanded and categorized social cues into 5 types: physical, psychological, language, social dynamics and social roles.

Incorporating social roles into computer agents was dated back to the 1960's when ELIZA, a program that takes the role of a psychotherapist. Fascinatingly, its creator found that people would sometimes interact with ELIZA as if the program is a real therapist. (Weizenbaum, 1966). Computing products that are presented as a social role often adopts roles that are in the positions of authority, such as, teacher, expert, or judge. The level of incorporation can range from a still image of the role to interactive animations with movements and voice-overs.

Although Fogg categorized these cues into 5 distinct types, it is obvious that they are often interconnected when incorporated into products to elicit social response. For example, creating an effective social role might require a mixture of physical characterizations as well as language to convey appropriate image of that social role to the users.

3.3. "Social Roles" as Cue

Many social roles in our everyday life are clearly defined. (Golder & Donath, 2004). Some roles are defined by governmental mean, such as police officer and prime minister; others are recognized by their profession and prestige, such as doctors and supervisor. Interestingly, family roles take on both personal and legal foundation. Within a society, each social role is usually expected to have a specific set of skills, responsibilities and privileges. For example, doctor social role is expected to have skill sets required to practice medicine, to be competent, efficient, reliable and helpful (Sztompka, 2003).

Over the years there have been several notable products that implement social roles to elicit desired behaviors from their users. For example, "Ask Jeeves" (currently "Ask") was a search engine that employ the use of butler social role by the name of "Jeeves". The image of a butler could influence the users to feel more served or helped. The visual character and the easy-to-remember name would also help to create an on-going relationship between users and the search engine, which could influence them to come back and use Jeeves' service more often.

4. PRELIMINARY SURVEY ON TRUSTWORTHINESS IMPRESSIONS OF MEDICAL-RELATED SOCIAL ROLES AMONG THAI AND JAPANESE

4.1. Survey Design

According to CASA paradigm, trust relationship between users and product could be fostered by incorporating social cues into the product and applying the same social principles that govern human-to-human trust. The focus of this paper has been to create an impression of trustworthiness in self-care home medical devices through incorporating “social roles” into such devices.

A preliminary survey was conducted to evaluate the trustworthiness perceptions and character trait impressions Thai and Japanese people have towards seven selected social roles that are related to the use of home medical devices. Stakeholders map for medical product created by Prestero (2012) was examined. Several medical-related roles such as doctor, nurse, hospital lab technician and health consultant were considered; this is coupled with roles that have personal connection with self-care user, such as parents, friends and lovers. The number of roles were narrowed down to seven, combining both medical-related and personal-related roles and ranging from most personal to most distant roles:

1. Friend
2. Spouse/Boyfriend & Girlfriend
3. Parents
4. Caretaker/Nurse
5. Fitness Trainer
6. Doctor
7. Hospital Lab Technician

To estimate trustworthiness perception of each role, 10 items with 7-point semantic differential scales were used. The items were adapted from Wheelless and Grotz's Individualized Trust Scale (1977). In the selection and adaptation of items, the concept of cognitive and affective trust by Lewis & Weigert and Johnson & Grayson, and Tschannen-Moran & Hoy's 5 facets of trustworthiness perception were considered. The final trustworthiness perception items are as followed:

- Uncaring-Caring
- Passive-Helpful
- Strict-Kind
- Authoritative-Friendly
- Subjective-Objective
- Unintelligent-Intelligent
- Hard to Understand-Easy to Understand
- Discreet-Open
- Different-Similar
- Untrustworthy-Trustworthy

4.2. Survey Result

26 Japanese participated in the study, 14 of which were male. 31 Thai participated and 12 of which were male. The combined number of participants was 57 with 46% male and 56% female. Principal Component Analysis was applied to the survey's data. For trustworthiness

perception items, there were two components with eigenvalues greater than 1 and both account for 50.26% of total variance. In interpreting the corresponding factor loading data, items with factor loading greater than 0.6 were considered. Note that “Untrustworthy-Trustworthy” item was not included in the PCA, as the items are presumed to be dimensions of trustworthiness perception. The 2 components and factor loadings for each items are as followed:

Table 1: 2 Principal Components and corresponding factor loading for each items

Component 1		Component 2	
Friendly	.773	Intelligent	.772
EasytoUnderstand	.664	Objective	.717
Kind	.660	Helpful	.643
Similar	.527	Caring	.582
Open	.481	EasytoUnderstand	.344
Caring	.436	Similar	.193
Helpful	.413	Friendly	-.027
Intelligent	-.014	Kind	-.070
Objective	-.222	Open	-.324

Based on Johnson & Grayson’s definition of cognitive and affective trust (2005) presented in Section 2.2, component 1 exhibits the requirements for affective trustworthiness, which comprises of feeling of care and concern or in this case “friendliness” and “kindness”. Interestingly, being “easy to understand” is also loaded on component 1.

Component 2 is comprised of “intelligence”, “objectiveness” and “helpfulness”, this exhibits the requirements for cognitive trustworthiness, which is based on competence and reliability of the target of trust.

The residuals of PCA was plotted to create an image map of trustworthiness perception, based on the 2 components, for the 7 social roles. A total of 3 maps are presented here: Fig. 1. Combined score from Japanese and Thai participants, Fig. 2. Score from Thai participants, Fig. 3. Score from Japanese participants

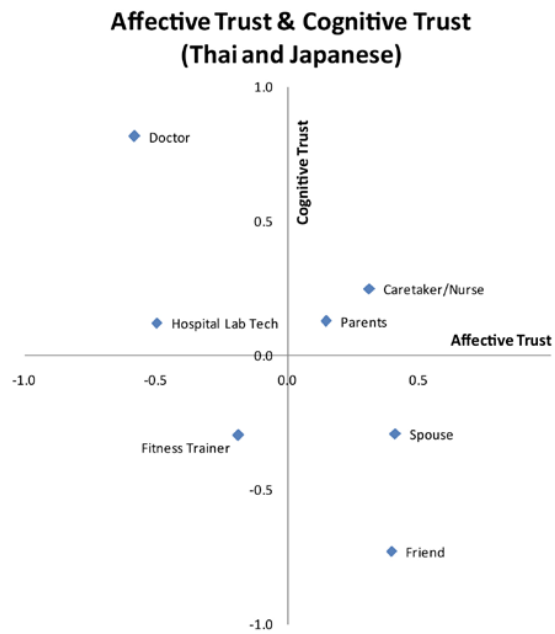


Figure 1: Image map of 7 social roles based on Affective and Cognitive Trustworthiness components (combined score between Thai and Japanese participants)

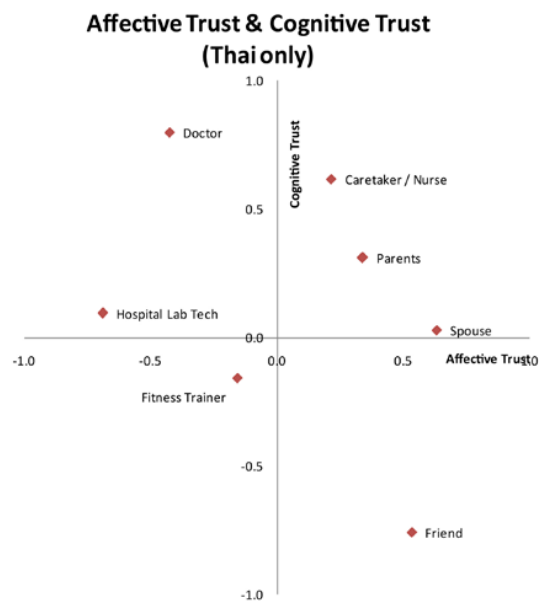


Figure 2: Image map of 7 social roles based on Affective and Cognitive Trustworthiness components (score from Thai participants only)

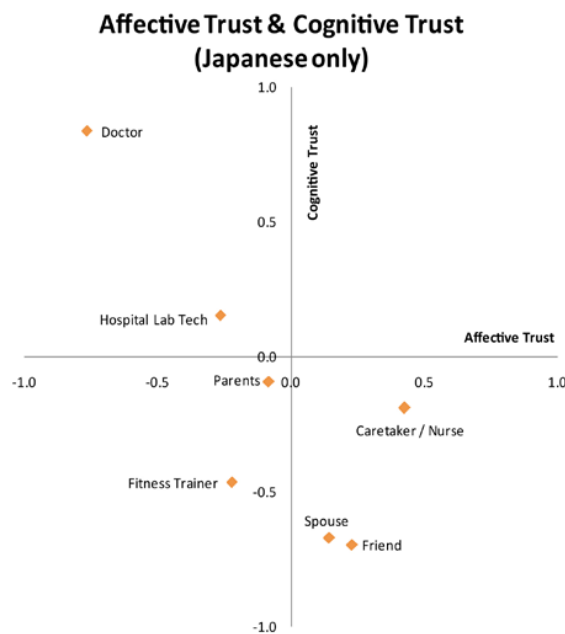


Figure 3: Image map of 7 social roles based on Affective and Cognitive Trustworthiness components (score from Japanese participants only)

The trustworthiness rating for “Friend”, “Doctor”, “Hospital Lab Technician” and “Fitness Trainer” social roles were consistent across Thai and Japanese participants.

Friend, in general, was rated very low regarding cognitive trustworthiness, but scored as one of the highest regarding affective trustworthiness. Doctor on the opposite end scored extremely high on cognitive trustworthiness, but very low on affective trustworthiness. Interestingly, Thai generally rated both social roles slightly higher in affective trustworthiness.

Hospital lab technician was perceived as somewhat cognitively trustworthy, but scored negatively regarding affective trustworthiness. Japanese gave a higher rating for both components. Fitness Trainer was rated negatively for both cognitive and affective trustworthiness. For this role, Thai gave a higher rating for both components.

The roles of “Spouse”, “Parents” and “Caretaker/Nurse” show very interesting results. For Spouse, Thai participants generally gave positive rating to both affective and cognitive trustworthiness, with the affective trustworthiness rating being the highest among the 7 social roles. Japanese, however, rated spouse role as somewhat affectively trustworthy, but very negatively with regards to cognitive trustworthiness.

Similarly, the role of parent was rated relatively high with regards to both cognitive and affective trustworthiness among Thai respondents, but slightly negative on both cognitive and affect among Japanese respondents.

The overall combined score shows Caretaker/Nurse social role to be in positive quadrant for both components, which means that the role is generally perceived as having a combination of both affective and cognitive trustworthiness across Thai and Japanese respondent. However, when Thai and Japanese ratings were examined separately, the role is perceived by Thai as being very cognitively trustworthy, but only slightly affectively trustworthy. Conversely, it is perceived by

Japanese as being more affectively trustworthy (in comparison to Thai), but not so cognitively trustworthy.

Table 2: Showing mean score for “trustworthiness” for 7 social roles (the “1 to 7” scale in the survey was converted to “-3 to 3” scale for PCA, with 3 being most trustworthy)

Untrustworthy-->Trustworthiness	Overall	Japanese	Thai
Friend	1.91	2.12	1.74
Spouse&BF,GF	2.42	2.73	2.16
Parents	2.61	2.62	2.61
Nurse/Caretaker	2.42	2.54	2.32
Fitness Trainer	2.09	2.08	2.10
Doctor	2.63	2.62	2.65
Hospital Lab Technician	2.32	2.38	2.26

The mean scores for untrustworthy-trustworthy item above show roughly similar score across the 7 social roles as well as both Thai and Japanese. For the overall score, Friend is rated least trustworthy while doctor is rated most trustworthy.

4.3. Discussion

The image maps of trustworthiness perception for the 7 social roles may prove to be useful when determining which social roles to incorporate into products. When the product is required to look trustworthy with regards to its functionality and efficiency, social roles that score higher on cognitive trust component, for example, doctor, may be more appropriate, as they are perceived as being objective and intelligent. On the other hand, products that want to establish an easy-to-use and friendly image may want to incorporate roles that score higher on affective trust component, for example, friend social role.

The role of spouse, caretaker/nurse and parents show a very interesting result with regards to cultural differences. They both score as one of the highest in untrustworthy-trustworthy items across the two cultures, but Japanese tend to give a lower score with regards to cognitive trustworthiness component. Again, this may account for contextual differences, or in this case cultural differences with regards to the combination of trustworthiness dimensions. In other words, simply fulfilling every cognitive and affective trustworthiness criteria may not result in the social role being perceived as trustworthy, as the combination of these facets of trustworthiness perception may be different from one culture to the next.

The social roles that are in positive quadrant for the image map could be considered effective in projecting an image of trustworthiness, as they both exhibit both cognitive and affective qualities of trustworthiness perception. That is, they are perceived as both intelligent and friendly with regard to trust-related characteristic. When compared to the mean score of untrustworthy-trustworthy item, roles in positive quadrant (parents and caretaker/nurse) have one of the highest scores. It might be safe to generalize that roles that fulfill both cognitive and affective criteria would generally be perceived as trustworthy overall. Again, this will also depend on the context in which roles are presented, or, in relation to social cues, how they are integrated into the products.

5. EXPERIMENT

5.1. Overview

In the preliminary survey, selected social roles were investigated on how they are perceived in relation to different dimensions of trustworthiness perception. As a follow-up, the main experiment for this paper will be about how social roles would be best presented in self-care medical device in order to bring highest perception of trustworthiness to that particular product.

The specific aim of the experiment is to investigate different methods of incorporating “Caretaker/Nurse” social role into blood pressure monitor’s cuff, and their effectiveness in conveying impression of trustworthiness of BPM device in Thai and Japanese young adult populations (20-39 years of age).

In choosing the social role to be used as cues in this experiment, the cross-cultural evaluation of trustworthiness as represented in Figure 1 was considered. From the image map, Caretaker/Nurse seems to be perceived as being positive on both cognitive and affective trust components (highest in the top-right quadrant). The role’s overall score in untrustworthy-trustworthy item are also among one of the highest. As the planned experiment would be focused on the methods for implementing social roles into medical product, choosing Caretaker/Nurse would be most appropriate, as its high rating on trustworthiness item itself as well as related dimensions of trustworthiness would likely produce a stronger impression when presented as a social cue in products.

The cuff-type blood pressure monitor is chosen as the target self-care medical device for the experiment. User’s familiarity and the importance of blood pressure monitor in self-care environment are the main reasons it is selected.

5.2. Method

The incorporation of social role is executed on the most basic level: static image printed on device. Also, as the patients have to manually wrap the cuff around their upper-arm, the user-device interaction involved in this experiment is mainly physical or “non-digital” in nature. The mere incorporation of static image of social role, if proved to be enough to generate positive psychological effects on the users, could be used on a wide variety of medical equipments - manual and highly technological. It will also serve as foundational study for future studies on more dynamic and interactive incorporation method.

The specific method of social role incorporation conducted in this study is to alter the graphical design on the blood pressure monitor’s cuff. The content of the design will be a graphical image of nurse, different at each level to alter the strength of social role visual characterization. The alteration methods are based on examining different types of social cues and examples of design with social roles.

The most common methods of incorporating social roles that were observed in the examples and examined as social cues by Fogg (2003) are the inclusion of facial features and use of text to convey social dynamics (in this case, naming). This was taken into considerations and the treatment levels, were developed as followed (figure 4):

Design A - Cuff with Omron’s Pre-made Design

Design B - Cuff with Blank Design

Design C - Cuff with Image of Caretaker/Nurse with no face

Design D - Cuff with Image of Caretaker/Nurse with face

Design E - Cuff with Image of Caretaker/Nurse with face and name “Mary”



Figure 4: 5 cuff designs from Design A to Design E

Omron's pre-made original design (A) was included as a treatment level to assess user's impression of current medical design of cuff. The final designs and naming for the caretaker/nurse image were derived from the result of preliminary survey as well as review of designs by focus group.

The designs of Caretaker/Nurse role was fitted onto an outline in the shape of the cuff and the positioning of the image undergone several revisions to make sure that the caretaker/nurse image is maximally exposed when the participants wrap the cuff on their upper-arm. After the positioning was finalized, all the designs were printed onto white cloth using flock printing technique in the monotonous blue color – design that was tested best in pre-experiment design reviews. Flock printing gives the cuff's cover a soft-to-the-touch texture. The printed covers were then attached to Omron's cuff using adhesives and were alternated according to treatment groups.



Figure 5: Experimental set-up, including cuff with caretaker/nurse cover on and BPM screen with white felt cover

The set-up for the device is shown in Figure 5. The monitor itself is covered with white felt cloth, cut out into the shape of the screen and only shows the reading necessary for this experiment

(blood pressure readings and pulse rate) and the “measure” button. This allows the participant to focus solely on the design of the cuff.

To investigate the differences in response for the 5 design variations from 2 nationalities, the experiment included 10 treatment groups, each with 5 participants ($N = 50$). 5 groups were Thai participants and another 5 Japanese. Each group has approximately equal amount of male and female. Due to small numbers of participants, some were asked to participate in 2 treatments. The order of the treatments are randomized and each group contained approximately equal amount of “before” and “after” participants.

User’s perceptions of the cuff designs were evaluated through responses to a questionnaire. The first part of the questionnaire is designed to evaluate user’s emotional states and feeling when he or she was using the device. It includes 4 items from Two-Dimensional Mood Scale (TDMS) for momentary mood states (Yosuke, Kentaro, Takeshi, 2013) and 3 items adapted loosely from Brave, et al. (2005). Note that the TDMS items are given to the participants to complete before and after using the blood pressure monitor, in order to measure momentary mood change. Emotional and mood measuring items are included to account for any emotional effects the different level of trustworthiness perception may have on the users. For example, according to Tschannen-Moran and Hoy (2000), one of the benefits of trust is to reduce the “anxiety” of having to worry about many uncertainties in our increasingly complex world.

The second part consists of 6 items that measure user’s impression or opinion about the cuff. 4 items are based on components in perception of trustworthiness: cognitive trust component represented by “impression of high functionality” (translated from “intelligence” item in impression of social role survey) and affective trust component represented by “easy to understand” and “easy to use”; another item asks users directly how much they perceive the device to be “trustworthy”. The remaining 2 items were adapted from likeability items from Brave, et al. (2005): “pleasant” and “attractive”.

The third part includes nine 7-point-semantic-differential items, designed to assess the personality of cuff designs.

The final part is consisted of 2 questions, and are meant to evaluate user’s trustworthiness impression of the BPM result and satisfaction with the product in general.

The questionnaire was originally written in Japanese and was translated to Thai. All Thai participants completed the questionnaire in Thai and all the Japanese in Japanese.

5.3. Result

It was found that there was no statistical difference in user’s perception of cuff’s trustworthiness across 5 designs, as assessed from “impression of trustworthiness” item in the questionnaire. ($F(4,40) = 0.800$, $p = .406$, partial $\eta^2 = .093$). Users found all of the cuff designs to be quite trustworthy, scoring between 3.2 and 3.6 out of 5 ($M=3.42$) across five designs in both nationalities. Cross-cultural comparison shows that Thai perceived the five cuff designs in general to be more trustworthy than their Japanese counterpart. ($F(1, 40) = 5.769$, $p = .021$ partial $\eta^2 = .126$)

However, from the evaluation of components affecting perception of trustworthiness, Japanese found Design C (nurse with no face) to be easier to use than medical-looking Design A ($F(4, 40) = 2.639$, $p = .048$, partial $\eta^2 = .209$), and felt more confident when using Design D than when using Design A ($F(1, 40) = 8.100$, $p = .007$, partial $\eta^2 = .168$). These results show that Japanese found the image with no face to be more reassuring and easier to use than normal medical design.

Furthermore, after using cuff with Omron's medical design (Design A), Japanese users became more irritated ($t(4) = -4.000$, $p=0.016$, $d=-1.78885$) and felt less pleasurable ($t(4) = -6.000$, $p=0.004$, $d=-2.68328$) according to TDMS, while there was no negative change in pleasurable feeling after using other designs. This illustrates that Japanese seem to be negatively affected by medical-looking products, becoming more displeased and irritated after using them.

There was no significant differences among the ratings of the 5 designs by Thai participants. The momentary mood states before and after cuff usage also show no different except in Design E (nurse face with name), where there was a positive increase in liveliness after using the cuff ($t(4) = 3.162$, $p = 0.034$, $d=1.4142$).

Cross-cultural comparison shows that Thai rated the five designs significantly higher than Japanese in many items. They found the five cuffs to be more trustworthy, of higher functionality, easier to understand, more pleasant and attractive in general. Thais also perceived Design A, C and D to be more interesting than Japanese did.

The perception of price and quality was assessed in "expensive-looking -- cheap-looking" item. Blank Design B was perceived as looking cheap in comparison to Design A ($F(4,40) = 0.509$, $p = .730$, partial $\eta^2 = .048$); however, the other designs with nurse image are perceived as equally expensive-looking as A. Note that the materials used to make design B, C, D and E are the same. This may suggest that without the incorporation of social role (Design B), the cuff with plain, blank color design is perceived as being cheaper than the designs with social role image.

6. DISCUSSION

The inclusion of static image of caretaker/nurse social roles did not improve the *direct* perception of trustworthiness of the BPM cuffs. It also did not reduce the trustworthiness level, when compared to Omron's original medical design. However, Japanese generally found cuff designs with nurse image to be more reassuring and easier to use, and Thai felt more lively after using one of the designs with nurse image. In addition to this, blank design with plain blue background (B) and medical-looking design (A) had a tendency to irritate Japanese. This observation suggests existing effects of incorporating social roles image into the design. Although it does not illustrate that there was a positive *direct* effect on trustworthiness perception when pictures of nurse were incorporated into the blue color designs, the incorporation of social roles did maintain the level of trustworthiness evaluation, while improved the mood and overall usage experience of the BPM that can be linked to trustworthiness perception (i.e. positive changes in TDMS, reassuring, easier to use); noted that this is in comparison to original medical design (A) with no social role image included.

In addition, cross-cultural examinations suggest that Japanese are more negatively affected by medical-looking designs than Thai are, especially with regards to pleasurable feeling. This suggests a significant difference in cultural perceptions of medical device. Whereas Japanese seem to associate medical-looking products with irritation and unpleasurable feelings, Thai are less susceptible to such negative impacts from these products. When compared to Japanese, Thai also gave higher ratings on cuff's trustworthiness, functionality and attractiveness. This suggest that Thai users generally view medical devices more positively than Japanese do, which would also explain why they were not easily affected with regards to momentary mood change by using such medical-looking product.

The preferences of incorporation methods - image without face, image with face, image with face

and name - are also noteworthy. Japanese found nurse image with no face to be reassuring and easier to use, but felt more confident when using the image with face, both in comparison to medical looking design. Thais were unaffected emotionally by these two designs. However, when the name "Mary" was added to the nurse's image, both Thai and Japanese reacted positively after using the design. Thai became livelier while Japanese felt more energetic. This may suggest that as the image of social role is perceived as more "human" - with face and then name - the user associates the product more with the stereotypical characters of the included social role, which may help to explain the positive effects of social role observed in the experiment.

Although the main experiment in this paper was not successful in increasing the direct impression of trustworthiness in home-use medical device through incorporating static image of caretaker/nurse social roles into the external design, the nurse designs did evoke some positive responses that can be linked to trustworthiness perception from the users. Future research could perhaps focus more on a dynamic or interactive method of role incorporation that will hopefully create a stronger impression of social role and become a more effective cue in general. Moreover, if we were to think of integrating social roles as building a personality into the device, it might also be interesting to observe how users develop a relationship with the product over a longer period of time.

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