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## Human Affordance in the Social Context of N-to-1 Communication

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**Abstract:** In this paper, we briefly introduce our proposed concept of "human affordance", which is afforded from humans, not artifacts. This is an extension of the concept of original affordance to cover human-to-human communication. As one possible application of the novel concept, we describe the example of the social context of communication from multiple people to an individual. The characteristics of "N-to-1 communication" are analyzed using a questionnaire survey on hand-writing and message privacy. The results are considered in designing of the E-Yosegaki tool.

**Keywords:** human affordance; N-to-1 communication; hand-writing; privacy control; E-Yosegaki.

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## 1 Introduction

The term of affordance comes from the perceptual psychologist Gibson, who provided an ecological alternative to cognitive approaches (Gibson, 1966; 1979). His theory is that *the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill*. Many studies in the field of psychology focused on affordance in human communication (Acker & Valenti, 1989), however the concept of affordance is most popular in the field of user interface design as it provides a means of enhancing the usability of physical artifacts rather than a human communication tool (Norman, 1988).

We focus on applying the original concept to human-to-human communication and propose the novel concept of "human affordance". Human-to-human communication often fails due to a lack of appropriately afforded information. For example, text-based communication such as text chat or instant messenger sessions suffers from many weaknesses compared to face-to-face communication; these include a lack of facial expressions, gestures, and intonation. Information with sufficient affordance is critical in developing mutual understanding since it elucidates how the speaker feels or what he/she is thinking about.

To design better human communication tools, it is important to understand how many people will be engaged in the communication act. In most cases it is not easy to determine this number accurately. When multiple people are engaged in communication, we have to consider the social psychology of the ensemble so formed. Particularly in the case of only one recipient, most senders focus on a shared point, "the recipient's special occasion" such as a message card for a wedding or farewell situation.

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In this paper, we apply the human affordance concept to the social context of communication from multiple people to an individual and introduce our message communication tool, "E-Yosegaki". The characteristics of "N-to-1 communication" are analyzed using a questionnaire survey on hand-writing and message privacy.

## **2 Human affordance**

### *2.1 Definition*

Affordance involves relationships or properties. It is difficult to define affordance in precise analytical terms. One definition of general affordance is that it is a set of perceptual information of an environment and an internal property of the environment such as a human's action capability. Similarly human affordance can be defined as a set of perceptual information of the human and the internal properties of the human. For example, one internal property, the emotion of agreement, can be perceived from the facial expression, such as a smile, as a piece of perceptual information. Note that human affordance focuses on an individual in human-to-human communication while social affordance (Acker & Valenti, 1989; Valenti & Good, 1991; Loveland, 1991; Stoffregen, 2004), studied in the field of psychology, focuses on relationships or interactions in a community.

Awareness has been discussed as one of the most important factors in a computer-mediated communication system (Bradner, 2001; Dourish & Bly, 1992; Erickson et al., 1999). The term of awareness is related to existence or state. On the other hand, the focus of affordance is on a set of perceptual information and internal properties which are not necessarily limited to dynamic properties such as state, but includes static properties such as ability. For example, consider the user who knows important information but who hesitates to speak out. Awareness research does not discuss this kind of static property.

### *2.2 Human affordance model*

Figure 1 shows the cognition model based on human affordance. In this figure, (1) the giver offers three kinds of perceptual information,  $P_LA$  to  $P_LC$ , to the perceiver. Perceptual information  $P_LA$  covers three internal properties,  $I_{pA_1}$  to  $I_{pA_3}$ . The perceiver has sensors such as eyes or ears, which are used to gather the perceptual information from the giver. (2) Interest which exists in the perceiver's mind, establishes an entry in a sender slot in the perceiver (slot 1); (3) the slot's content interacts with perceived information  $P_D A$ . (4) Based on the content of the sender slot, the corresponding perceived information  $P_D A$  is focused upon, which creates an entry in a receiver slot (slot 2). (5) The receiver's knowledge (his/her database), which is referred to according to the content of the receiver slot triggers an entry in a receiver's cognition slot (slot 3). The perceiver's database has a lot of knowledge about the relationship between common perceptual information and internal properties. The result of this process is that the sender affords internal property  $I_{pA_1}$  to the perceiver.

The above is a quite simple but widely applicable affordance model. This applicability is important since it allows the model to be reused by the creation of metaphors. A set of perceptual information and internal properties can be defined

automatically or manually according to the situation or person. In some cases, user profiles or agent-based communication support techniques would be effective in identifying the set of perceptual information and internal properties.

### 2.3 Perceptual information and internal properties

Perceptual information can be categorized into the kinds discerned by sensors; eyes, ears, nose, and skin. A more detailed classification of perceptual information can be made based on components of the perceptual information and measurable parameters. For example, hairstyle is associated with "look" and utterance frequency in a chat is a measurable parameter. Moreover, changes in these parameters are also perceptual information. Internal properties can be divided into states and nature. A state is a dynamic factor such as a facial expression or thought, which changes moment by moment. Nature covers static factors such as ability or priority.

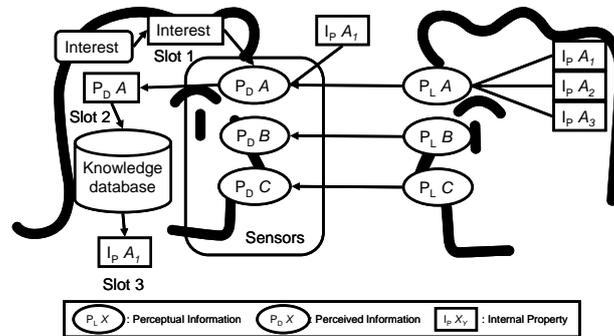


Figure 1 Human affordance model

### 2.4 Difficulties in affordance cognition

An everyday artifact does not have many affordances and its main affordance is clearly discernible. For example, most people understand that a mug is a tool for holding liquids to be drunk. A human, however, is capable of a wide variety of actions and has many internal properties. It is not easy to recognize human affordance due to this variety and the restriction that we are limited to perceptual information (appearance) when assessing an unknown person. This is true whether we are holding a face-to-face meeting or using a text chat system, although it is obvious that the problems are much stronger in the latter.

Human affordance cognition can fail in three ways:

- No useful perceptual information is provided
- Insufficient perceptual information is provided
- Wrong perceptual information is provided.

In the first case, we say that the internal property is not expressed. For example, a meeting participant knows something of value but makes no expression or utterance. In

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the second case, the perceptual information provided is insufficient. For example, the low image resolution provided by most videoconferencing systems hinders smooth interaction based on facial expressions. The most common solution is to improve transmission quality. In the third case, the perceptual information cannot be used to discern the internal property. An example is a participant who smiles while actually being unhappy about what is being discussed. In everyday life, we use a priori knowledge to prevent such misunderstandings. A lack of positive confirmation may be useful in understanding the participant's true feelings. In this case, the priori knowledge of "he would say something if he were happy" can be used to infer his true internal property. This paper discusses one example of the third case; failure to understand a message sender's positive emotion such as his/her celebration of a wedding.

#### *2.5 Affordance augmentation*

The above problems in affordance cognition can be solved by an affordance augmentation system (AAS). Such a system can offset the lack of incorrect perceptual information by creating the right affordance or enhancing affordance.

People tend to believe that a quiet participant has no interesting or useful information. If the AAS could recognize the value of the participant, it could encourage him/her to speak. That is, the AAS would create true and useful affordance. Consider a videoconference system that uses facial avatars based on computer graphics and can enhance the motion of facial parts such as the eyes. Emotion, one internal property, could be conveyed by graphics enhancement instead of using a photorealistic video. In another case, one problem with text chat among people is the failure to recognize the utterance requests by participants. The AAS could graphically enhance the utterance requests of key participants by actions such as framing their windows in red.

Affordance augmentation has two advantages. One is that it more fully utilizes computers for human communication. The other is that it creates a really effective communication style that is unavailable in the real; it differs from the face-to-face communication of everyday life.

### **3 N-to-1 communication**

Designing a communication tool requires an understanding of the number of people who will be engaged in the communication act. Typical of 1-to-1 and N-to-N communication are text chat and videoconferencing, respectively. Email can be used for both 1-to-1 and 1-to-N communication. Although there are N-to-1 communication tools such as the online guestbook, a tangible N-to-1 tool that can be used in face-to-face situation remains unknown and applying our human affordance concept to the N-to-1 context will yield better understanding of how to design an N-to-1 communication tool.

#### *3.1 Human affordance in N-to-1 context*

N-to-1 communication often fails due to social factors. For example, a group of people sometimes write encouraging comments and their names on a solid, single sheet of paper for their friend and give it to him/her on special occasions such as a wedding reception or a farewell party. This letter is called "Yosegaki" in Japan. An example of a real Yosegaki

is shown in Figure 2. In the typical Yosegaki situation, although some message writers try to convey their positive emotions to a recipient, they hesitate to disclose their own emotions to the other writers. In order to solve such a problem in the N-to-1 context, it is important to consider how to augment human affordance with regard to hand-writing and privacy control. In such a Yosegaki situation, the perceptual information and internal properties of hand-writing are the written messages and the writer's emotion, respectively. Examples of the corresponding privacy concerns are the number of written sentences and the strength of emotion disclosed.



Figure 2 A real Yosegaki

### 3.2 Development of E-Yosegaki tool

We developed an E-Yosegaki tool for N-to-1 communication that offers hand-writing and privacy control. The first E-Yosegaki prototype, shown in Figure 3, is based on a commercial tablet computer. A user can write a message on the tablet using a pen input device.

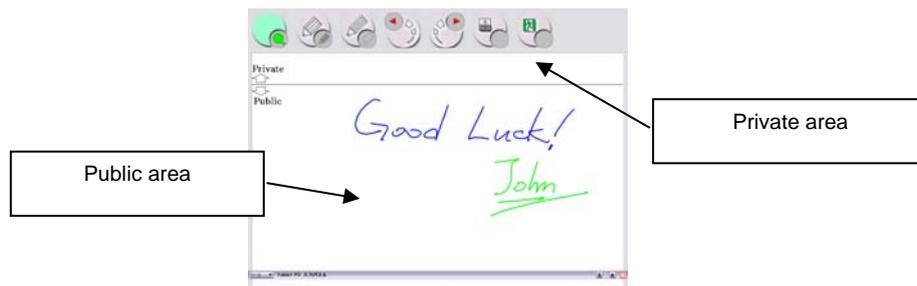


Figure 3 Developed prototype of E-Yosegaki

When the user clicks any point in the main window, a message writing window will appear that occupies the whole screen of the tablet. A screenshot of the message writing

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window and the main window are shown in Figure 4 and Figure 5, respectively. The user can enter both public content and private content in separate areas. In the example of Figure 4, the upper area is for private content and the lower is for public content. This separation can be used to realize privacy control of written messages in the Yosegaki situation. The recipient can view written messages using our newly developed viewer program on a tablet computer that can be physically handed to the recipient or sent to his/her computer as message data later.



**Figure 4** A screenshot of the message writing window



**Figure 5** A screenshot of the main window

## 4 Experiments

### 4.1 Experimental design

We conducted a questionnaire survey which focused on the impact of writing by hand a message to an individual at a special occasion with regard to message warmth and the need for writer-controlled message privacy. 60 subjects (22 males and 38 females) ranging in age from their teens to their 50s were asked to choose one of five levels in response to each question.

#### 4.2 Hand-writing

We asked the subjects to answer the following two questions about hand-written messages in a real Yosegaki;

Q1. How strongly do you rate the importance of hand-writing? (“5” is strongest.)

Q2. How often do you actually put emotion into your message? (“5” is “very often”.)

#### 4.3 Privacy control

In a real Yosegaki, users cannot erase a written message and it remains open to any reader. This makes the writers nervous. We asked the subjects to answer the following two questions about message privacy in a real Yosegaki;

Q3. How strongly do you worry about the privacy of your own message? (“5” is highest.)

Q4. How do you rate the number of sentences that you write? (“5” is “many”.)

### 5 Results

#### 5.1 Hand-writing

Figure 6 plots the answers to Q1 and Q2 as a histogram. Most subjects rated both questions highly which confirms the importance of hand-writing. However, some subjects rated Q1 high but Q2 low. These results suggest that E-Yosegaki can assist the user in creating more emotional messages as a hand-writing tool on special occasions where people should create warm messages.

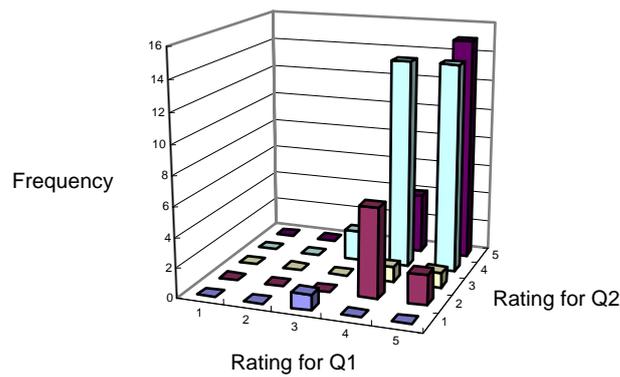
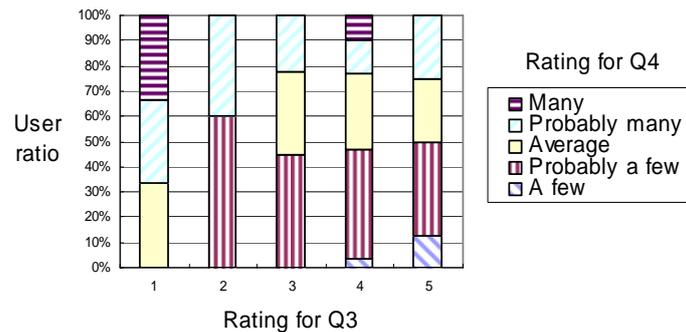


Figure 6 Answer correlation: Q1 and Q2

## 5.2 Privacy control

Figure 7 shows the results for Q3 and Q4. Subjects who worried about message privacy frequently selected "write only a few sentences" for Q4. On the other hand, subjects who did not worry about privacy selected "write many sentences".



**Figure 7** Answer correlation: privacy (Q3) and amount of message content (Q4)

## 6 Discussions

A tablet computer enables many users to hand write messages that can generate strong positive emotions. Such messages are missing in the current electronic society due to the huge number of typed messages. The fact that a message sender has put all his/her heart into writing the message makes us feel happy while the hand written letters themselves create warm messages.

Written message privacy should be also considered. In a real Yosegaki, message writers control only the content of their own message. It is assumed that all messages will be viewed by everyone freely. These concerns can be eased by E-Yosegaki because each message can be hidden (if desired) until all people have finished writing; the full set of entered messages can be read only by the recipient.

When multiple people are engaged in communication, we have to consider the social psychology of their associations. Of course, it strongly depends on their community. If all writers in the community are strangers to each other, strict privacy control will be essential. On the other hand, if they know well each other, they may enjoy their collaboration in writing without privacy control. Particularly in the case of only one recipient, most writers focus on the same point, "the recipient's special occasion". Such case has the potential for establishing not only sympathy but also funology (Blythe et al., 2004) which reflects the confidence among community members.

The first prototype is only a basic implementation of N-to-1 communication. To develop the E-Yosegaki tool, we employed the same metaphor of hand writing on the tablet as hand writing on a real Yosegaki. This approach was adopted to make the developed tool acceptable as a friendly interface. A Yosegaki is a gift for a recipient and message warmth by hand writing is essential. To employ a tablet computer for hand

writing is reasonable; however other styles of interface can be considered such as the tangible interface, cell phone, and PDA. Networked message input may be needed for participants at remote locations. The real Yosegaki prevents such participants from joining in. The networked E-Yosegaki eliminates this handicap.

## **7 Related work**

One example of research on affordance is the analysis of the concept of affordance with regard to understanding human activity (Bærentsen & Trettvik, 2002). Most studies on affordance, however, lie in the field of engineering, particularly the design of user interfaces (Amant, 1999; Conn, 1995; Gaver, 1991; 92). Designing computer-mediated communication systems is also an important research field. (See the "Human Affordance" section describing "awareness.") Authors proposed the novel concept of "human affordance," which is generated by humans, not artifacts. (Ihara et al., 2009).

As shown in Meyer's survey on pen input devices (Meyer, 1995), many studies have examined hand-writing as a means of communication. We can also find related works in the research fields of privacy and collaborative work. Single Display Groupware enables co-present users to collaborate via a shared computer with a single shared display and the simultaneous use of multiple input devices (Stewart et al., 1999). DOLPHIN supports the concept of public as well as private workspaces in a meeting; entry is via a pen interface (Streitz et al., 1994). Baecker described the design requirements for collaborative writing software (Baecker et al., 1993), one focus of which is document control by one person or several people. Our focus on N-to-1 communication creates a significant difference from these works.

## **8 Conclusion**

In this paper, we applied the concept of human affordance to the social context of N-to-1 communication. The characteristics of N-to-1 communication were analyzed by assessing the results of a questionnaire survey on hand-writing and message privacy. This paper also presented our initial implementation of E-Yosegaki and a study on improving its design with such reference to the characteristics of N-to-1 communication.

This work envisions that the new paradigm of human affordance will be a key design foundation for human-to-human communication systems in terms of user-centered design. Future work includes developing and evaluating affordance augmentation methods as user support technologies as well as evaluating the E-Yosegaki functionalities of hand-writing and privacy control.

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