# Towards Augmenting Human Affordance in Evaluation of Agreement/Disagreement Phrases

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## ABSTRACT

*Our final goal is to utilize a cognition viewpoint for engineering of better design of human communication tools. In this paper, we extend the concept of affordance to cover human-to-human communication and propose the novel concept of ''human affordance,'' which is afforded from humans, not artifacts. As one possible utilization of the concept, we introduce the example of affordance in evaluating the strength of agreement / disagreement phrases. In text-based communication, it is important for mutual understanding to effectively afford information about how a person feels about the text itself. This paper presents experimental results on understanding the strength of agreement/disagreement and presents one simple example to augment human affordance in text-based communication.*

## INTRODUCTION

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. These are important for conveying how a person feels or what he/she is thinking about. In text-based communication, it is important for mutual understanding to effectively afford information about how a person feels about the text itself.

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 a psychology field focused on affordance in human communication (Acker & Valenti, 1989), however the concept of affordance is popular in the field of user interface design as it provides a means of enhancing usability (Norman, 1988).

In this paper, with regard to utilizing a cognition viewpoint for engineering, we extend the concept of affordance to cover human-to-human communication and propose the novel concept of ''human affordance,'' which is afforded from humans, not artifacts. A model of human affordance is defined as a set of perceptual information and human factors. One advantage of human affordance is the focus it places on human factors which yields user-centered designs.

Accordingly, we describe the significance of augmenting affordance in text-based human communication and illustrate the concept through examples although this work is explanatory in nature. We analyze the human affordance found in typical agreement/disagreement phrases in order to better augment human affordance in text-based communication. This paper presents the experimental results on evaluating the strength of agreement / disagreement and presents one simple example to augment human affordance in text-based communication by phrase replacement.

## RELATED WORK

Text-based communication is getting popular as shown by examples such as text chat, instant messaging, and email. Several studies have examined text chat systems. Farnham et al. proposed a scripted chat system that uses Lead Line (Farnham et al., 2000) which allows users to add a layer of pre-authored structure to regular text chat. Vronay et al. identified the text chat problems related to the loss of timing-specific information (Vronay et al., 1999). Jozsef analyzed the impact of interactive graphics and text on social influence (Jozsef, 1994). DiMicco et al. introduced instant messaging with a skin conductivity channel (DiMicco et al., 2002).

Decision support is an important research field related to mutual understanding. Kenneth et al. reviewed group decision support for computer-supported cooperative work (Kenneth & John, 1988). Richard et al. explained the process of perspective taking and its roles in human communication, mutual trust, and organizational learning (Richard et al., 1992). John et al. described the significance of a common report space in addition to the messaging space (John et al., 1991). Mera et al. proposed a method to analyze users' affirmative/negative intentions from multiple utterances in spoken dialogs (Mera et al., 2001). Since these papers did not consider affordance in communication, they lack the ability to truly understand and thus support the user.

One example of research on affordance is the analysis of the concept of affordance to employ it for understanding human activity (Baerentsen & 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 (CMC) systems is also an important research field (Cassell et al., 2000; Bradner & Mark, 2001). (See the ''Human Affordance'' section describing ''awareness.'')

Authors have studied on typical responding phrases used in agreement/disagreement in communication (Ihara & Kobayashi, 2005). This paper discusses affordance for agreement / disagreement from the viewpoint of engineering in order to realize better system designs for text-based communication.

## PROMOTING MUTUAL UNDERSTANDING IN TEXT-BASED COMMUNICATION

Table 1 shows the methods that can be used to promote mutual understanding in text-based communication. In this table, 1 and 2 enhance the presentation of the text. The remainder, 3, 4, and 5, alter the design of the statement (word) database.

### Enhanced Presentation

In method 1, attributes are added to a text when it is presented to the partner such as a bigger font or red coloring. This method provides users with immediate understanding through visual comprehension. For example, Bodine et al. developed an instant messenger around kinetic Typography (Bodine & Pignol, 2003). Donath analyzed the effectiveness of graphics in online conversations (Donath, 2002). In method 2, a text is presented together with other media like voice. For example, synthesized speech with intonation may reinforce the expressive power of a text. Rothkrantz et al. added facial expressions to text balloons in cartoons (Rothkrantz & Wojdel, 2000). This is an example of combining text with graphics.

### Statement Database Design

In method 3, a statement database is enlarged by addition of explicit statements. One of most typical examples is the ''smiley'' which presents an emotion by a sequence of a few letters like :-). Smileys are so symbolic and explicit that users can easily understand the partner's intention to express his/her emotion. On the other hand, method 4 restricts the statements available to prevent misunderstand-

*Table 1. Methods to promote mutual understanding in text-based communication*

| | Method | Advantage | Examples | Approach |
|---|---|---|---|---|
| 1 | Add visual attributes to text | Immediate understanding through visual comprehension | Change size or color of fonts | Enhanced presentation |
| 2 | Use a text with other media | Reinforce text expressiveness | Play with synthesized speech | Enhanced presentation |
| 3 | Add explicit statements to database | Symbolic and explicit expressions | The ”smiley” | Statement database design |
| 4 | Restrict statements available in database | Simplified expressions | Textbook | Statement database design |
| 5 | Add attributes to statements in database | Familiar statements with higher expressiveness | Strength of agreement/disagreement | Statement database design |

ing. A school textbook is an example of this approach in terms of using only easy words. Method 5 adds attributes to statements in a database. This method makes it possible to use familiar statements without adding or restricting the statements available. Our approach to setting the strength of agreement / disagreement of each statement is one example of this method.

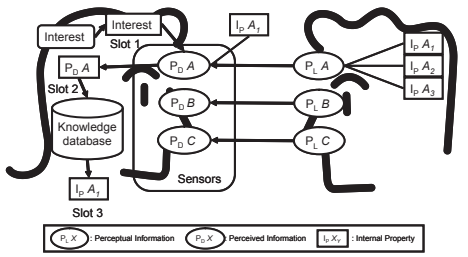
## HUMAN AFFORDANCE

### Definition

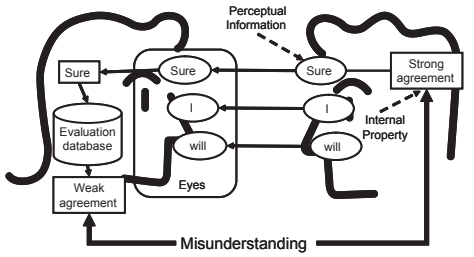
Affordance involves relationships or their properties. It is difficult to define affordance in precise analytical terms. One definition of general affordance is a set of perceptual information of an environment and an internal property of the environment such as a human's action capability. Similarly human affordance can be defined as a set of perceptual information of the human and the internal property of the human. For example, one internal property, the emotion of agreement, can be perceived from the facial expression of 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; Kadar & Effken, 1994; Stoffregen, 2004), studied in a psychology field focuses on a relationship or interaction in a community.

Awareness has been discussed as one of the most important factors in a CMC 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 an internal property which is 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 property.

*Figure 1. Human affordance model*




(a) A general human affordance model.




(b) A human affordance model of agreement.

### Human Affordance Model

Figure 1-(a) shows the cognition model based on human affordance introduced in this paper. In this figure, (1) the giver offers three kinds of perceptual information, $P_LA$ to $P_LC$, to the perceiver. Perceptual information $P_LA$ is related to 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; (3) the slot's content interacts with perceived information $P_DA$. (4) Based on the content of the sender slot, the corresponding perceived information $P_DA$ is focused on which creates an entry in a receiver slot. (5) The receiver's knowledge (his/her database) which is referred to according to the content of the receiver slot makes an entry in a receiver's cognition slot. 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 giver affords internal property $I_PA_1$ to the perceiver.

The above is a quite simple but highly applicable affordance model. This applicability is important to easily employ the model for engineering with a same metaphor. A set of perceptual information and internal property can be defined automatically or manually according to a situation or a person. In some cases user profiles or agent-based communication support techniques would be effective to identify the set of perceptual information and internal property.

### 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 as a facial expression or thought, which changes moment by moment. Nature covers static factors such as ability or priority.

### 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) in 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:

1. No useful perceptual information is provided
2. Insufficient perceptual information is provided
3. Wrong perceptual information is provided.

In the first case, we say that the internal property is not expressed. For example, a participant knows something of value but makes no expression or utterance. In 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; wrong understanding of agreement/disagreement in text-based communication.

## 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 or incorrect perceptual information by creating the right affordance. It can also enhance affordance to make up for insufficient perceptual information.

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 forth. This means that the AAS would create the 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. An emotion as an internal property may be conveyed by graphics enhancement instead of using a photorealistic video. In another case, one problem with text chat among people is cognition of the utterance requests by participants. The AAS can 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 to create a really effective communication style that is unavailable in the real world and differs from face-to-face communication in everyday life.

## HUMAN AFFORDANCE IN AGREEMENT / DISAGREEMENT

People afford their agreement / disagreement to a partner in communication using several types of agreement / disagreement phrases. However, the strength of agreement / disagreement that a partner feels about each phrase is not necessarily same as that of agreement / disagreement that they put into their response. Some people overestimate and others underestimate. The overestimation type of user may misunderstand weak agreement as strong agreement. The underestimation type of user may not understand or accept the other's comment as praise. This failure of human affordance leads to inhibit mutual understanding.

Figure 1-(b) shows one example of human affordance model in the case of agreement. In this figure, a user responds to a partner by using a sentence of ''Sure, I will...'' This responding user employs ''Sure'' as a strong agreement word. In this case the implementation of human affordance model definition is that ''Sure'' as a visible letter sequence is perceptual information and that the user's evaluation of strong agreement is internal property. In this example, the partner understands ''Sure'' as a weak agreement, thus there is a misunderstanding between their evaluations for the agreement strength of the word ''Sure''.

To decrease such a misunderstanding, it is important to identify the human affordance in agreement / disagreement phrases and to design a better method for affordance augmentation which can be applied for engineering.

## EXPERIMENTS

### Experimental Design

We analyzed responding phrases of agreement / disagreement to identify the human affordance in agreement / disagreement phrases. We collected about 100 responding phrases and used questionnaires to rate the strength of agreement / disagreement. In these experiments, phrase type and user type were analyzed to explore better augmented human affordance in text-based communication.

### Collecting Responding Phrases

We asked one hundred fluent English speaking subjects to list as many responding phrases that express agreement / disagreement as possible. The subjects were asked not to consider the situations in which the phrases could be used. The collected data included phrases used in both oral conversations and text-based conversations. We collected 67 phrases for agreement and 42 phrases for disagreement.

### Rating the Collected Phrases

Questionnaires were used to rate the responses in terms of the strength of agreement / disagreement. The subjects were another one hundred fluent English speakers who were categorized into 10 groups by gender and age (teens to 50s). The strength of agreement / disagreement was assigned one of five levels from ''strong (5)'' to ''weak (1).'' In the questionnaires, radio buttons for each level were positioned at equal intervals on the screen.

## RESULTS

It is important to identify phrase type in order to design better usage of agreement / disagreement. For mutual understanding, it is better that most users evaluate similarly the strength of agreement / disagreement. The success of the phrase usage depends on reliable metrics that can well represent the strength of agreement / disagreement.

Tables 2-(a) and 2-(b) list the top ten phrases of large and small standard deviation (shown as SD in the table) in rating by all subject groups in gender and age,

*Table 2. A listing of the top ten phrases of large and small standard deviation in rating*

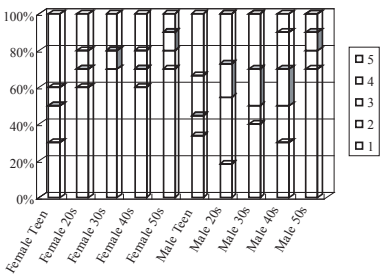
(a) Phrases: care needed.

| Agreement (SD) | Disagreement (SD) |
|---|---|
| Whatever (1.55) | Whatever (1.49) |
| Yeah (1.53) | Nah (1.40) |
| Yea (1.47) | Well (1.35) |
| Yup (1.45) | Oppose (1.35) |
| Mm-hmm (1.44) | Uh uh (1.34) |
| I know (1.42) | Not (1.30) |
| Uh huh (1.38) | Nope (1.29) |
| Alright (1.37) | Not a chance (1.29) |
| Awesome (1.34) | I don't think so (1.28) |
| Totally (1.33) | No way (1.28) |

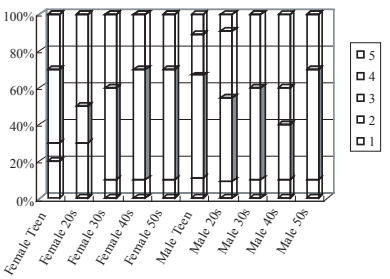
(b) Phrases: no care needed.

| Agreement(SD) | Disagreement(SD) |
|---|---|
| That sounds good(0.83) | Of course not(0.94) |
| Absolutely (0.91) | No(1.03) |
| Excellent(0.93) | Can't(1.03) |
| That's right(0.93) | I don't know about that(1.03) |
| You're right(0.94) | Absolutely not(1.05) |
| Sounds good to me(0.96) | Stop(1.05) |
| That's true(0.97) | Not really (1.05) |
| I totally agree(0.98) | That's wrong(1.06) |
| Great(1.00) | Never(1.07) |
| Definitely (1.00) | Disagree(1.10) |

*Figure 2. Rating results for two types of phrase*




(a) Rating results for "Whatever" (agreement).




(b) Rating results for "That sounds good".

respectively. The phrases shown in Table 2-(a) need to be handled with care while those in Table 2-(b) can be used relatively freely.

The most interesting phrase in Table 2-(a) is ''Whatever'' which ranked at the top of both agreement and disagreement columns. Figure 2-(a) is the rating result for ''Whatever'' in agreement. In this figure, the horizontal axis categories each subject group in gender and age and the vertical axis plots the ratio of each rated level in the evaluation. As shown in Figure 2-(a), subjects in each gender and age group assessed the expression ''Whatever'' quite differently. This is because ''Whatever'' can be used for either agreement or disagreement. A subject who rated ''Whatever'' as a 5 may have misunderstood weak agreement as strong agreement and someone who rated it 1 may not have understood other's praise.

On the other hand, as shown in Figure 2-(b), most subjects evaluated the expression ''That sounds good'' in the same way. ''That sounds good'' is a very safe phrase in terms of avoiding misunderstanding in communication.

## DISCUSSIONS

One simple way of augmenting human affordance for an overestimating type of user is replacing the phrase that the partner used with another phrase of weaker agreement / disagreement. We compared two subjects in order to explore the potential of phrase replacement. The most overestimating user in our experiments overrated the strength of agreement phrases by 1.16 on average compared to the average user.

Figure 3 shows a comparison of the ratings produced by the normal user and the ''adjusted'' ratings by the overestimating user. In this figure, the vertical axis plots those ratings. The adjusted ratings were calculated by subtracting the factor of 1.16 from the original rating; subtraction was not performed on phrases that both users rated 5. As shown in Figure 3, this simple subtraction created 25 matched ratings by those two users (originally, there were 14 matches). Also, in Figure 3, a vertical line between o and x means a gap between the rating by the normal user and the adjusted rating by the overestimating user. As shown in the figure, the number of large gaps (more than 2) decreased from 14 to 7.

A lot of methods can be used for augmenting human affordance in agreement / disagreement. Here is one example for the overestimating user. Both phrases ''Excellent'' and ''Sounds good to me'' are phrases for which no care is needed in Table 2-(b). However, ''Excellent'' is a high rating phrase and may be overestimated by the overestimating user. Thus, using ''Sounds good to me'' instead of ''Excellent'' is better for the overestimating user. The fact is that the overestimating user rated ''Excellent'' as 5 but rated ''Sounds good to me'' as 3, while the normal user rated ''Excellent'' as 3.

## CONCLUSION

In this paper, we proposed the novel concept of ''human affordance'' which is afforded from humans, not from artifacts and presented its definition and model with perceptual information and internal properties of humans. We also introduced experimental results on understanding the strength of agreement / disagreement in text-based communication. Analyses of those results in phrase type and user type provided findings towards better augmentation methods of human affordance in text-based 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 a user support technology.

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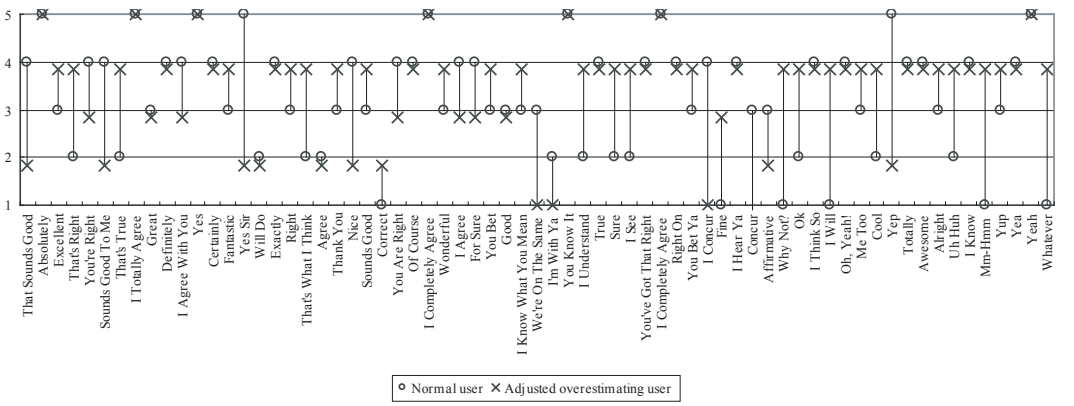
*Figure 3. Comparison between a normal user and an adjusted overestimating user*



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